April 2020

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- Covid-2019 Myth Busters
- India's Aditya to Study the Sun
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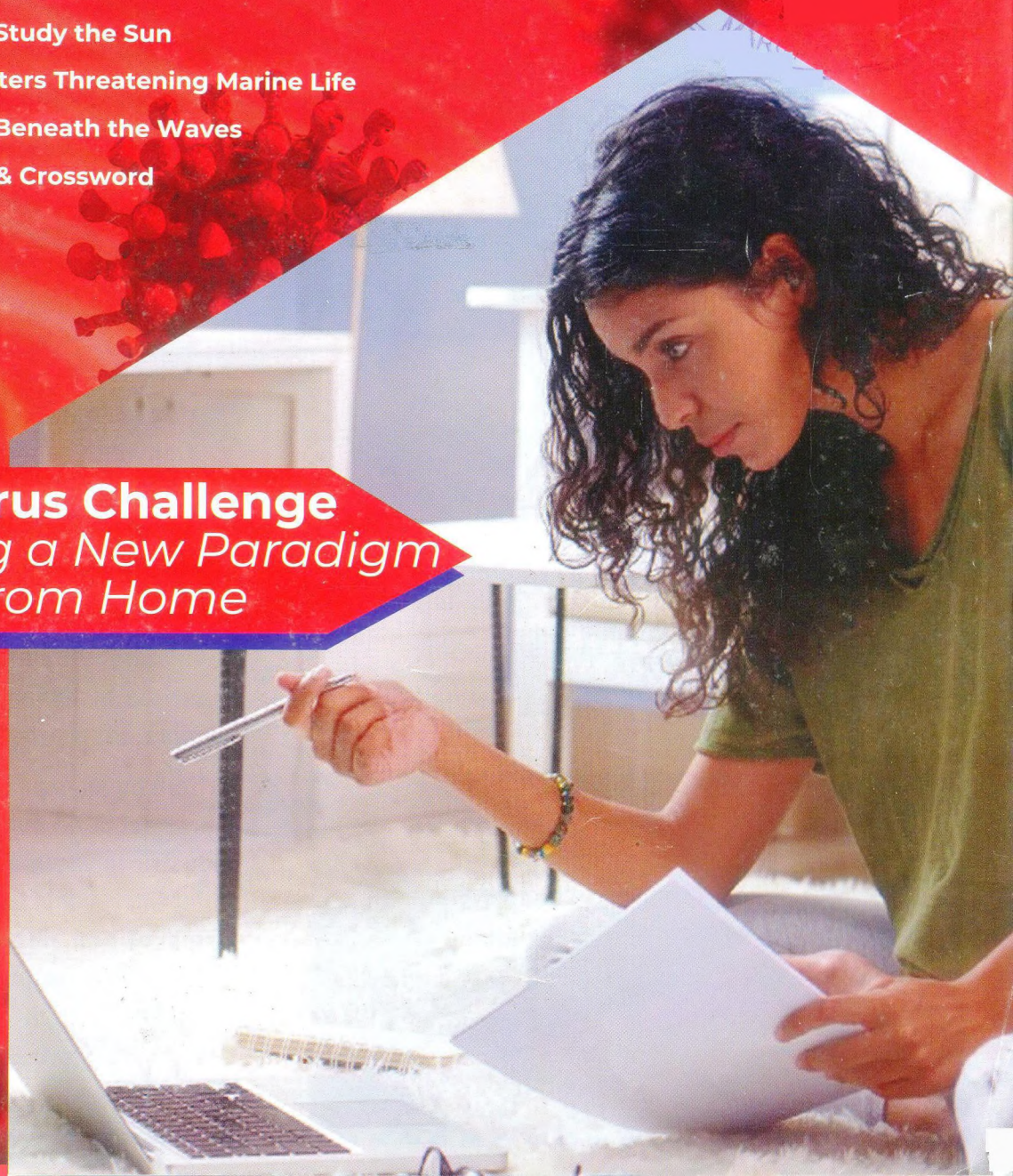

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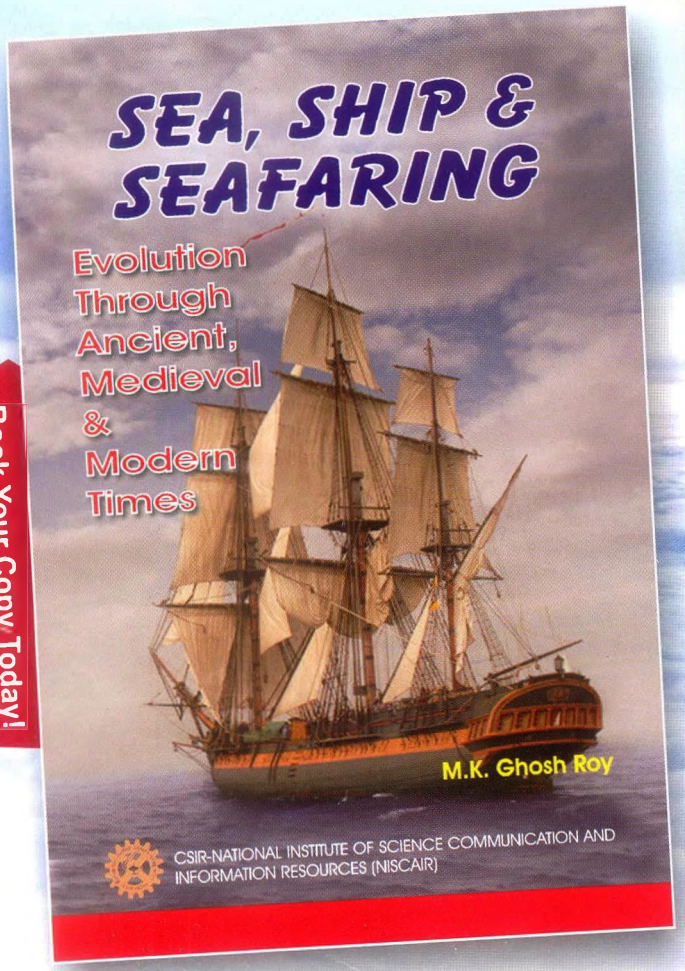

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Contents

CORONAVIRUS COVERAGE

Editorial
#CoronavirusOutbreak ..... Pg 9

CSIR Efforts in Combating Coronavirus ..... Pg 28

CSIR-NISCAIR Awareness Poster ..... Pg 29

Coronavirus Myth Busters ..... Pg 34

ARTICLES/SHORT FEATURES

Turning Ocean Waters Acidic: Threatening Marine Life ..... Pg 21
Vijai Dharmamony

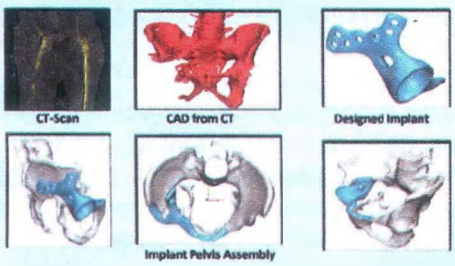
Aditya-L1: First Indian Mission to Study the Sun ..... Pg 25
Anand Kumar Sharma

Lychee Fruit: The Good, the Bad and the Ugly ..... Pg 30
Aditya Rao SJ

Communicating Beneath the Waves ..... Pg 38
Gobardhan Sahoo

CSIR Technology Showcase

3D-Printed Patient-Specific Medical Implants ..... Pg 32
Meher Wan



COVER STORY

Coronavirus Challenge Pg 14
Propelling a New Paradigm of Work from Home
Anand Parthasarathy

IN CONVERSATION

If you aim for the sky there is no limit!
Vritant Kumar Pg 36

REPORT

Science Communication Conclave 2020
Meher Wan Pg 42

18th Science Fiction Conference
Srinarahari Pg 44

The Man from the Nine Dimensions
Vasumathy Jambunathan Pg 46

BOOK REVIEW

Butterflies of the World
S. Suresh Ramanan Pg 49

DEPARTMENTS

REACTIONS 8
PUZZLE CORNER 52
WHAT'S NEW 54
INNOVATIVE MINDS 58
NATURE'S MARVEL 60
CROSSWORD 64

MAKING INDIA A GLOBAL PLAYER

WITH reference to the feature article **Making India a Global Player** (*Science Reporter*, February 2020), Science, Technology and Innovation are undoubtedly crucial to the solution of India's problems, but another most invaluable tool required is to develop 'scientific temper' among citizens of the country.

Pandit Jawaharlal Nehru, the first Prime Minister of the country, stressed on 'scientific temper' for eradication of all kinds of superstition. Of all developing countries, India has incorporated the phrase 'scientific temper' in Article 51 A of her Constitution as one of the fundamental duties by 42nd Constitutional Amendment Act in 1976 because scientific temper is seen to be elusive in spite of tremendous growth in S&T.

The former President Dr APJ Abdul Kalam had identified five interrelated areas, based on core competence, for transforming India into a Global Player by using S&T: (1) Agriculture and food processing; (2) Infrastructure; (3) Education and health; (4) Information and Communication Technology (ICT) and (5) Critical technology and Strategic industries.

Jaydev Jana, IAS (Retd)
Kolkata
jaydev.jana@gmail.com

RING OF FIRE

IT is my pleasure to share the experience of guidance and support from several articles published in *Science Reporter*. I would like to mention a particular article by Mr Debasis Sarkar titled **Ring of Fire — Double Bonanza for India**, published in December 2019 (Vol 56 No. 12) for the help during the recent Annular Solar Eclipse. A good and thorough scientific hands-on study material was needed for observing as well as capturing the eclipse, and in this prime moment, I went through the article by Mr Sarkar.

The article contains information about the exact timings of different phases of the eclipse for various regions in India. It helped me choose my location. The most enlightening part of the article was the discussion about camera setup and different aspects of shooting and viewing an eclipse. Lastly, excellent background information about all possible safety measures for eye as well as equipment completes the proper guidance for an amateur sky enthusiast like me.

I would like to share the picture of the eclipse I took from Payyanur, Kerala as a warm appreciation to the writer and editor.

Sourav Gope
JRF, School of Physical Sciences
Indian Association for the Cultivation of Science

THE PARADOX OF ZERO

RINTU Nath in the article, **The Mighty Zero** published in the April 2012 issue and Asis Kumar Chaudhuri in the article, **Much ado about Zero** published in October 2016 issue of *Science Reporter* have presented historic perspectives on the invention and spread of the concept of zero and the unique characteristics of zero. However, the dichotomy of zero as a number and a place holder has not been resolved as yet. We present here an alternative view on zero in this regard.

One big paradox in mathematics is that the same number zero (0), when placed before a digit has no value (nothing) and does not affect the value of the succeeding digits whereas on placing it after a number, it enhances the value of that number tenfold (10x) by enhancing the value of the preceding digit(s) ten times. No other whole number from 1 to 9 has this property. However, the same symbol (0) and the same term (zero) are being used to represent both the values, i.e. "nothing" and "10x", which is irrational.

It would be logical and appropriate if different terms and symbols are used to represent the different values of zero. We propose that the symbol θ should be used to denote "nothing" when placing it before any digit from 1 to 9 (e.g., θθ7) or after a decimal following a digit (e.g., 29.θθ) or before a decimal but not preceded by any digit (e.g., θ.θ1). On the other hand, the same old symbol 0 should be used to represent its value as 10x when placing it after any digit from 1 to 9. To further simplify things and to avoid any confusion, θ (nothing) can be called "void" whereas, 0 with a place value of 10x can be continued to be termed as "zero".

The proposed scheme is easily implementable worldwide without any changes to the existing keyboards as "double strike-through" command can be used along with the "0" key to create the symbol θ.

Jag Mohan Saxena
Retd Manager, State Bank of Bikaner & Jaipur
Hari Mohan Saxena
Ex Dean, Bihar Animal Sciences University, Patna

Attention Authors!

- Choose informative, interesting, creative and topical scientific subjects to write on.
- Avoid academic, specialised and technical subjects.
- Write in a popular style to make the article/write-up appealing for a wider readership.
- Provide original photographs wherever possible.
- Do not forget to mention your name, current affiliation, complete, correct postal address, and e-mail.

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SARLA DUTTA
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ASHWANI KUMAR BRAHMI
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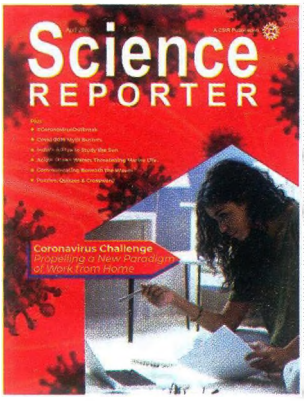

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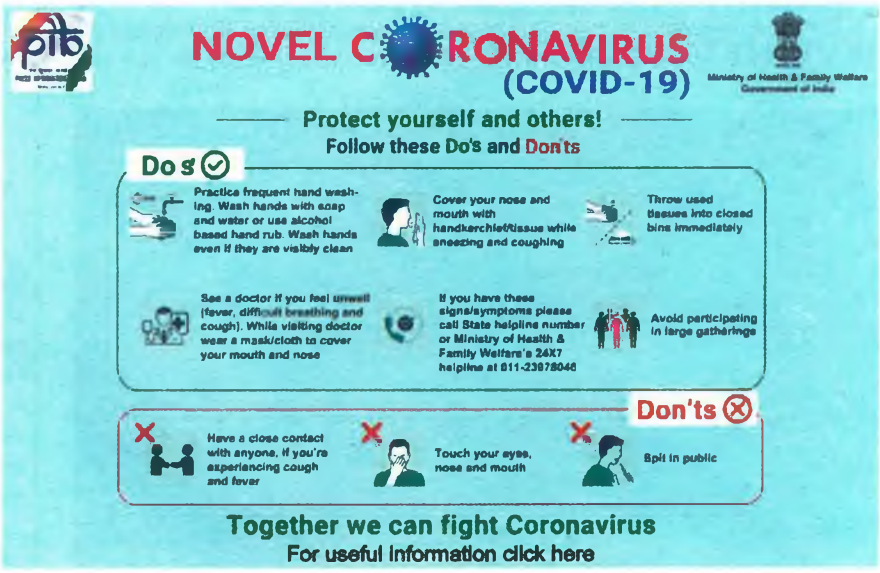

IT is rarely that an issue that has been dealt with earlier in this column remains significant enough through the month to warrant yet another mention. The coronavirus outbreak fits the bill.

From December 31 last year when China alerted the World Health Organisation (WHO) to several cases of an unknown virus causing unusual pneumonia in Wuhan city to the identification of the virus as the Novel Coronavirus-2019 on 7th January, and then from reports of the first death in China on 9th January to swiftly racing to 735,875 confirmed cases from 199 countries and 34,949 deaths by 30th March – the virus has been on a relentless march until now, with no signs of any abatement yet.

The Prime Minister has called for not lowering the guards without giving in to any undue panic. Indian authorities have so far diligently, responsibly and in copybook style taken much of the steps required to halt the deadly virus in its tracks, although the same cannot be said of some confirmed coronavirus cases who have run away from isolation wards to potentially infect many others they come into contact with.

With the authorities seized of the problem, much of the responsibility for staving off the crisis created by the virus also lies with the citizens. Several messages are being flashed about some very simple preventive actions that we can take to prevent the virus from expanding its reach – keeping the surroundings and surfaces clean, washing hands regularly, covering the mouth while sneezing and coughing, avoiding mass gatherings and promoting social distancing, isolating oneself at the first signs of sickness, avoiding unnecessary travel, and so on.

There are many uncertainties built into the entire episode. Will the virus outbreak wane as summer approaches? Until now there are no firm pointers that the virus would be affected by the heat of the summers although there are several conjectures in this regard. Another issue that has exercised experts is whether mass testing will be helpful in diagnosing cases of coronavirus infection. Indian medical authorities have clarified that at this stage mass testing could exhaust resources and leave us vulnerable if and when the disease enters the community transmission stage.

Since until now there is no effective treatment or vaccine available against the coronavirus disease, and since health authorities are already taking effective steps, responsible and preventive action on our part could delay the spread of the disease into local communities giving our health authorities a longer window to procure testing kits and prepare better equipped health facilities.

Hasan Jawaid Khan

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Henneguya salminicola
The animal that doesn't Need Oxygen to Respire

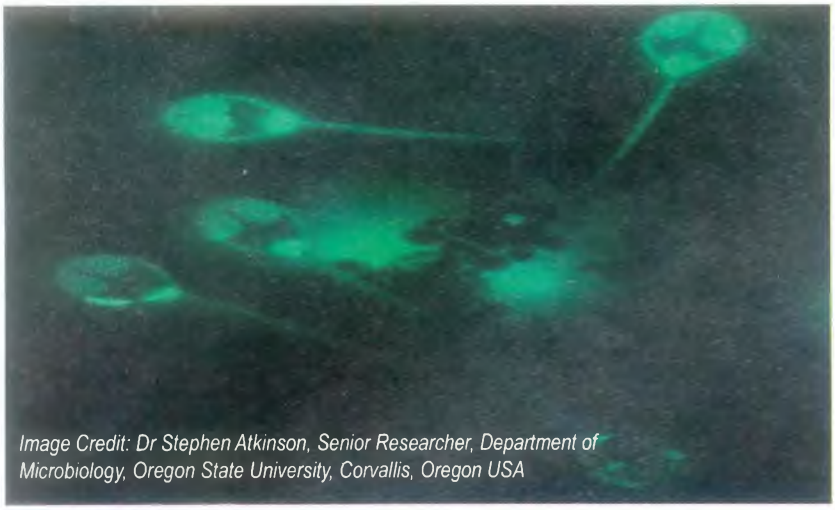


Image Credit: Dr Stephen Atkinson, Senior Researcher, Department of Microbiology, Oregon State University, Corvallis, Oregon USA

OXYGEN is vital for the functioning of all multi-cellular organisms, however, scientists have recently found a species of animal that exists without oxygen.

The animal is a parasite called *Henneguya salminicola*, a member of the jellyfish family. It survives in the muscles of salmon and trout, resulting in little white nodules known as "tapioca disease." This discovery was led by Dorothée Huchon, Zoology Professor in the Faculty of Life Sciences and the Steinhardt Museum of Natural History at Tel Aviv University, Israel.

According to the scientists, it will bring a whole new dimension to the understanding of animals. While many microbes have evolved the ability to live without oxygen, animals are much more complex with different kinds of tissues and organelles. Till date, it was believed that all animals undergo a process called 'cellular respiration', which is the conversion of sugars and oxygen to energy molecules known as ATP by an organelle called mitochondria, and these organelles possess their own "mitochondrial" genes.

The discovered parasite is also known to infect coho, pink, sockeye and chum salmon as well as rainbow trout. The parasite completes its life cycle in two organisms — fish and worm. The parasite is comprised of about ten cells and can live without the machinery to turn oxygen into energy.

The researchers reported these findings in the journal *Proceedings of the National Academy of Sciences*.

While sequencing the genomes of *Henneguya,* extracted from a Chinook salmon and related fish parasites, it was noticed that *Henneguya*'s mitochondrial genes were missing. Initially, the scientists thought it was an error but DNA fluorescent staining also revealed the absence of mitochondrial DNA. Many of the genes of enzymes involved in respiration were also found to be missing with the mitochondrial DNA.

However, the scientists are still not sure from where this animal derives its energy. There is a lot to look forward to in this unfolding story.

Contributed by Harshada H., MSc Science Communication student, CSIR-NISCAIR

Image Credit: Dr Stephen Atkinson, Senior Researcher, Department of Microbiology, Oregon State University, Corvallis, Oregon USA

'Good News' for Treating Female Infertility

IN recent times, there has been a dramatic increase in the number of women experiencing infertility issues. According to the World Health Organization, infertility is a global public health issue. In India alone, 27.5 million couples suffer from infertility (*Times of India*, 2018). In fact, this serious issue has also been talked about in the latest commercial Bollywood movie '*Good Newwz*'.

In most cases, this situation arises because unlike males, females significantly lose fertility with increasing chronological age and female subfertility or infertility is often related to ovarian ageing.

Ovarian ageing or age-related physiological decline in the functioning

IISc Team Builds Through-the-wall Radar on Tiny Chip

A team of researchers at the Indian Institute of Science (IISc) has built a through-the-wall radar on a chip smaller than a grain of rice. The researchers led by Gaurab Banerjee, Associate Professor at the Department of Electrical Communication Engineering, developed the radar using Complementary Metal Oxide Semiconductor (CMOS) technology.

The radar has a single transmitter, three receivers and an advanced frequency synthesizer capable of generating complex radar signals, all packed together into a tiny chip. Its small size can enable mass production at a low cost. Such radars can have wide-ranging applications in the defence sector, as well as areas such

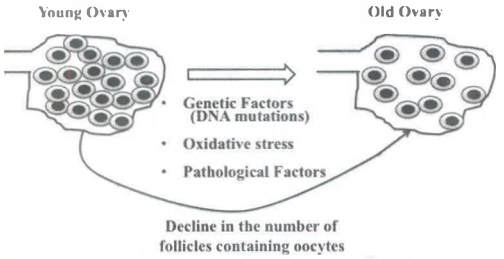


Figure 1. A schematic depiction of ovarian ageing

of ovary is typically exhibited by an increase in the fibrous tissue and a gradual decrease in the number as well as the quality of oocytes/follicle pool/ovarian reserve in the ovaries. In other words, the ovaries fail to produce oocytes, which are competent enough for fertilization and further development. Thus, in such a scenario, assisted reproductive technologies like IVF became quite useful.

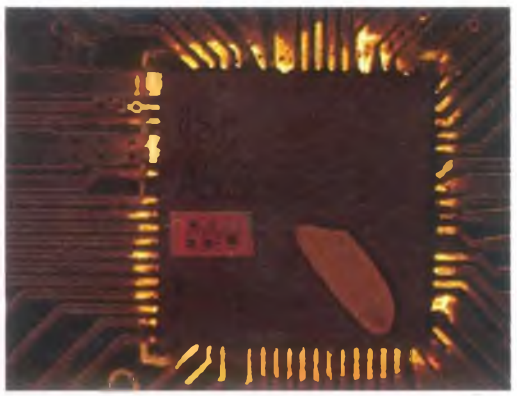
Various studies have reported different factors involved in ovarian ageing like genetic and environmental factors or some gynecologic disorders or diseases and treatments. Among these factors, 'oxidative stress' has been shown to play a critical role in the regulation of ovarian ageing (Fig. 1). The term "oxidative stress" states a physiological imbalance between the creation and the ability to detoxify free radicals or Reactive Oxygen Species (ROS, like superoxide anion radicals, hydroxyl radicals, and hydrogen peroxide), thus leading to resultant stress and damage to the cellular systems.

In a recent study by the Institute of Zoology of the Chinese Academy of Sciences, Peking University, and Salk Institute for Biological Studies, USA, the actual molecular mechanisms underlying the basis of human ovarian ageing have been elucidated using primates (cynomolgus monkeys) as animal models, followed by experimental validation in human ovarian cells (Wang, Si. *et al.* 2020. Single-Cell Transcriptomic Atlas of Primate Ovarian Aging. *Cell*, 180: 1-16).

In contrast to previous diagnostic methods (follicle count, measurement of ovarian hormones, etc.), which provided an indirect estimate of ovarian reserve of a female, this study has revealed several important genes associated with age-related decline of the ovaries. Among these, there were two key antioxidant genes (IDH1 and NDUFB10), which showed decreased function in the old ovaries due to oxidative stress which simply means that these genes play an important role in protecting non-human primates as well as human ovarian cells from cellular damage during ageing.

They can be used as biomarkers for the early diagnosis and treatment of female infertility as well as age-related ovarian diseases like ovarian cancer in humans. The detection of antioxidant genes will help in finding out the actual 'biological ovarian age', which will definitely be a more reliable measure of ovarian health rather than the chronological age.

Contributed by Dr Jaspreet Kaur, Assistant Professor, Zoology Department, Maitreyi College, University of Delhi. Email: jkaur@maitreyi.du.ac.in



A photomicrograph of the TWR radar-on-chip compared to a grain of rice *(Photo Credit: ARSL, IISc)*

as healthcare, transportation and agriculture.

"Only a handful of countries in the world today have the ability to put the entire electronics of radar on a chip," says Banerjee.

Radars work on the principle of bouncing a signal off an object and measuring the delay in the signal's return. These signals are analysed to identify the object — even reconstruct a crude image of it — or determine where it is or how fast it is moving. An extension of this technology is a Through-the-wall radar (TWR), which works on the principle that radio waves can penetrate walls when light cannot.

"TWR imaging has always been one of the most challenging radar design problems," says Banerjee. For one, the signal can get significantly damped while passing through walls. To overcome this, radio waves consisting of a large number of frequencies need to be used, which can complicate the design. These radars also use a more complex signal, known as a chirp, which requires customised electronics such as a microwave transmitter, a receiver and a frequency synthesizer.

With their design, the IISc team has now managed to squeeze all of these electronic components into a single, tiny chip. They used new architectural and circuit design techniques to overcome challenges specific to radars – such as the design of a wide fractional bandwidth transceiver. "The same design techniques that have enabled smaller and cheaper smartphones can now be used to miniaturise the complex electronics of a radar system into a small chip," says Banerjee.

Although the chip was originally developed for airport security-related applications, Banerjee's group is also exploring applications in other areas such as healthcare.

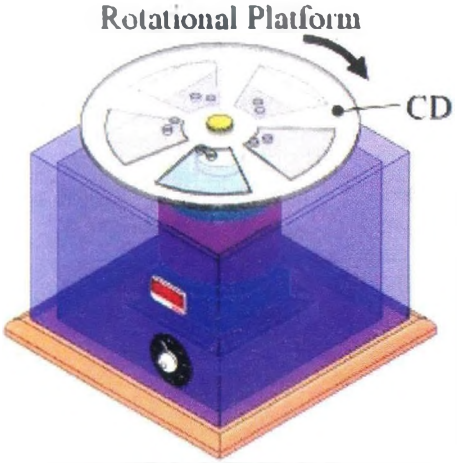
For instance, it can be used to monitor the health of elderly people. There are more than 10 crore elderly people in India, with many living on their own. If they slip and fall, and it goes undetected, it can lead to severe long-term problems. Although cameras and wearables have been used to monitor their movements, there are concerns about privacy and inconvenience. TWR radar systems, therefore, offer a convenient alternative.

"It might be possible for a centrally-placed TWR system to scan the house, and construct a model of when a person is standing or sitting down. If there is a sudden change in gait due to a fall, it can trigger an alarm," says Banerjee. "It could also monitor breathing and respiration rates and assess the severity of a fall."

IIT-KGP Develops Cost-effective CBC Test Kit

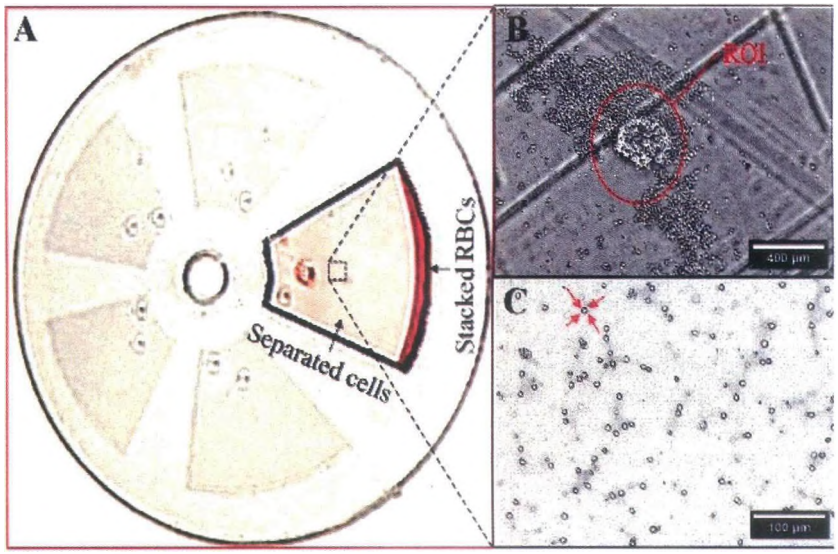
RESEARCHERS at the Indian Institute of Technology-Kharagpur (IIT-KGP) have come up with the innovation of a simple low-cost motorized spinning disc-based kit that can perform Complete Blood Count (CBC) Test. It costs a nominal 10 rupees, whereas the same tests cost around Rs 150-200 in government and private laboratories.

Complete blood count (CBC) is one of the common blood tests prescribed by doctors for clinical diagnosis and prognosis from anaemia, infection, viral fever, cancer, etc.



Set-up of the device

Separated Cells in CD grids



The project on the pocket-friendly disc-based CBC kit was lead by Prof. Suman Chakraborty from the Department of Mechanical Engineering, IIT-KGP.

The researchers have redefined the usage of the compact disc altogether. Different cells have different densities and thus these can be separated in transparent micro-fluidic channels by applying centrifugal force. After separation of cells, an innovative label-free imaging method is used to count the cells in different segregated regions. The accuracy of counting the cell in this arrangement is up to 95%.

This test is generally expensive because it needs an expensive microscope and a trained person. However, IIT-KGP's innovative method replaces the traditional manual counting of cells by a trained person by image processing by a trained software mechanism. This process also does not require any post-processing of separated blood – the disc of the micro-fluidic device can be disposed of after several tests.

The researchers have published the methodology and results in the journal *Biosensors and Bioelectronics (Elsevier)*. The researchers are now reaching out to MSMEs or related industrial organizations for commercial product development for the market.

Contributed by Hemant Kumar, Student, M.Sc. Science and Technology Communication, CSIR-NISCAIR, New Delhi

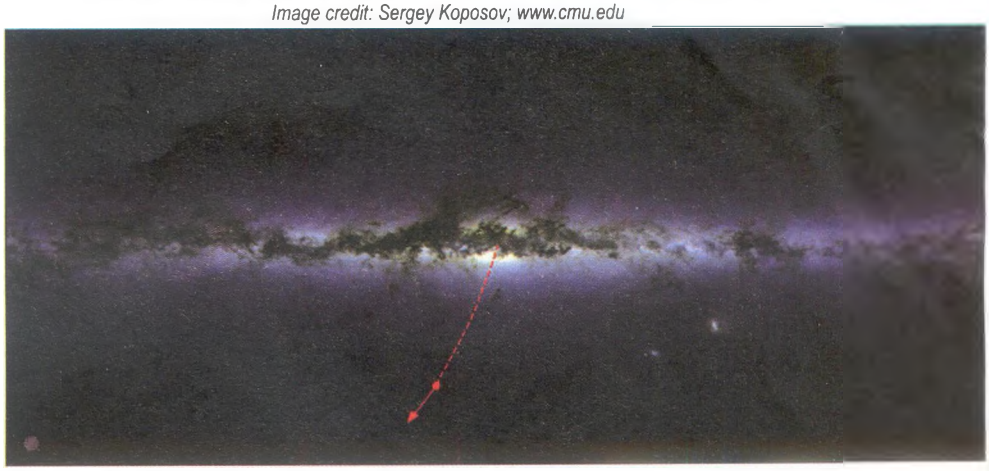
World's Fastest Ant

OF the 1200 species of ants known, a species known as Saharan Silver ant found in the desert are the world's fastest ants. These ants routinely brave the blazing hot-midday sun to forage for

Image credit: commoms.wikimedia.org

A Runaway Star Ejected by a Supermassive Black Hole

The location of the star on the sky and the direction of its motion. The star is flying away from the Galactic centre, from which it was ejected 5 million years ago.
Image credit: Sergey Koposov; www.cmu.edu



AN international team of astronomers has recently discovered a hypervelocity star whizzing out of the galactic core of our Milky Way at a staggering speed. The star was found to be moving ten times faster than most stars in the Milky Way and is headed for the darkest, loneliest depths of the intergalactic space. The results of this discovery were published online in the *Monthly Notices of the Royal Astronomical Society*.

Researchers led by Sergey Koposov of Carnegie Mellon University's McWilliams Centre for Cosmology have spotted the star, known as S5HVS1, in the Crane-shaped constellation Grus. According to researchers, the star is unprecedented due to its high speed (60 million kilometres per hour) and close proximity to the Earth; it is currently 29,000 light-years from Earth. Douglas Boubert from the University of Oxford and a co-author of the study, said, "The velocity of the discovered star is so high that it will inevitably leave the galaxy and never return."

The star SHVS1 was discovered with observations made with the help of the 3.9 metre Anglo-Australian Telescope (AAT) near Coonabarabran, New South Wales, Australia, coupled with superb observations from the European Space agency's Gaia satellite. The discovery was made as part of a study, known as Southern Stellar Stream Spectroscopic Survey (S5) — a collaboration of astronomers from the U.S., U.K., Australia and Chile. According to Ting Li, who is from Carnegie Observatories and leader of S5 collaboration, the star S5HVS1 is about twice as massive as our Sun and ten times more luminous.

The astronomers could trace the streaking star back to the galactic centre which is home to a supermassive black hole, known as Sagittarius A*, with a mass of four million suns. Actually, hypervelocity stars can be ejected by black holes through a phenomenon called Hills mechanism. First proposed by Jack Hills, a theorist at Los Alamos National Laboratory in 1988, Hills mechanism is a phenomenon that occurs when a binary star system is disrupted by a supermassive black hole. Tidal forces of the black hole cause one of the stars to be captured by it and fall into an orbit around it while the other star is jettisoned away from the black hole at a very high speed.

According to Li, the runaway star S5HVS1-an A-type main-sequence star-was ejected by the supermassive black hole, Sagittarius A*, at the heart of the Milky Way five million years ago, when humankind's ancestors were just learning to walk upright. "This is the first clear demonstration of the Hills mechanism in action," said Li, adding, "Seeing the star is really amazing as we know it must have formed in the galactic centre, in a place very different to our local environment. It is a visitor from a strange world."

Contributed by Dr P.K. Mukherjee, 43, Deshbandhu Society,15, Patparganj, Delhi-110092.
Email: mukherjeepradeep21@gmail.com

food. They are technically known as *Cataglyphis bombycina* and commonly known as Saharan silver ants.

These ants are one of the most heat-resistant animals known. Their critical thermal maximum is 56°C and they run at a speed up to 0.7 m/second. Their body is covered on the top and sides with uniquely triangular shaped hairs which serve as an antireflection layer that enhances the ants' ability to offload excess heat by thermal radiation which is emitted from the hot body of the ants to the air.

These ants have long legs to keep their bodies away from the sand. While running at high speed they use only four of their six legs, raising their front pair of legs.

This ant is the fastest of all well-known ant species. It covers 108 times its own body length per second. This is quicker than an Olympic 100 m runner.

They are active outside their nest for about ten minutes/day due to pressure of predation and temperature. They come outside in midday when the temperature is around 47°C. The whole colony of ants leaves the nest in search of food and have to complete their work before the temperature reaches 53°C.

The navigational capabilities of these ants have been the subject of numerous scientific investigations. The suggestion that the ants use polarized light as a guide, is contradicted by the observation that they are able to assess how far they have walked even in the dark. Another experiment concluded that the ants measure the distance travelled by sensory ability called proprioception that counted the number of steps taken.

The study was published in the *Journal of Experimental Biology* (October 2019).

Contributed by Dr K.Venkataraman, AT 2 Porkudam Apartments, Bypass Road, Madurai-6. Email: Venkat1941@gmail.com

Coronavirus Challenge

Propelling a New Paradigm of Work from Home

Anand Parthasarathy

The coronavirus pandemic forced governments and corporates worldwide to switch to a new paradigm: Work From Home. Could this be a viable option, even after the crisis passes?

THE more things change, the more they remain the same, runs a French proverb. Here is a striking illustration. Some five years ago, this correspondent had an interview fixed with an IBM executive in one of several offices of that company in Bengaluru.

On the appointed day I made my way to the office and was met in the lobby by one of IBM's corporate communications officers. "We need to go to Meeting Room no 2. Let me try and find it," she said. I was a bit surprised. Surely someone who worked there would know the geography of the place? Turned out she didn't work there – or in any of IBM's half a dozen locations in the city.

Like thousands of IBM staff, she 'worked from home' and came to office on rare occasions like this when she had to organise a media meeting. If for some reason she needed to work from office, she had to "book" a workstation in advance. She showed me a large hall with dozens of such cubicles, with a floating population of IBMites. After my interview was over, I went back to my home – and the lady did likewise, to hers.

More recently, I heard from a manager at the multinational tech company, Cisco, that some 60 percent of their staff, particularly in Indian metros, had the option of working either from home or from one of those serviced "workspaces" available for rent near their homes. Cisco saw no sense in thousands of staff spending three hours or more of productive time, commuting to the city's IT clusters.

"Work From Home" is therefore not a new concept. It has been around for over a decade (see box: "Flashback: the first home worker"). The concept has been called many things including Telecommuting and Remote Working. But the coronavirus pandemic suddenly made this a compulsion rather than an option.

The Indian government mandated that corporates allow as many as possible of their employees to operate from home – and set an example within its own walls. When an

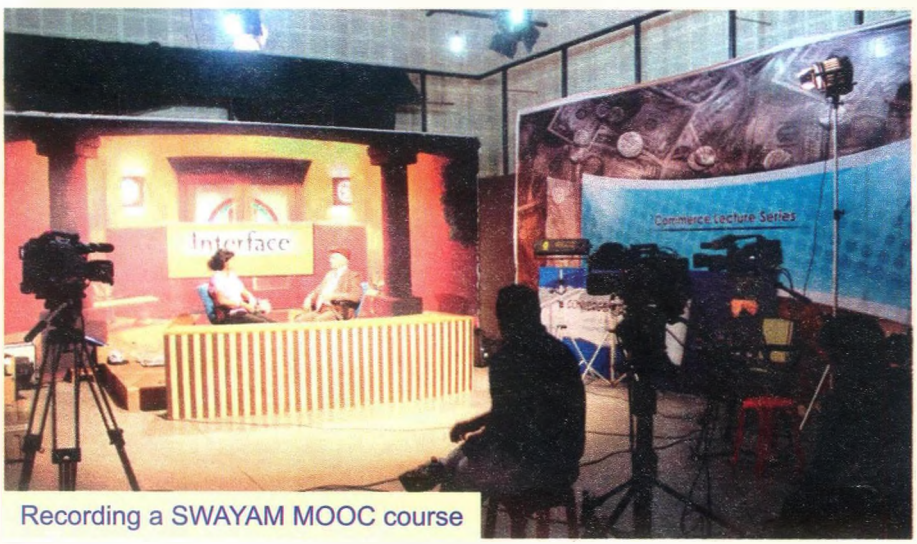
e-Learning: Touching a Broad Spectrum of Students

With students and professionals forced to stay indoors, the appeal of distance learning is compelling

For parents with young children, the challenge of how to slip in some study time into all those hours of TV binge watching has been met. The answer is e-learning: Internet-based curriculum-based coaching, at which leaders like Byju's, Unacademy, Khan Academy, etc. have excelled for some years.

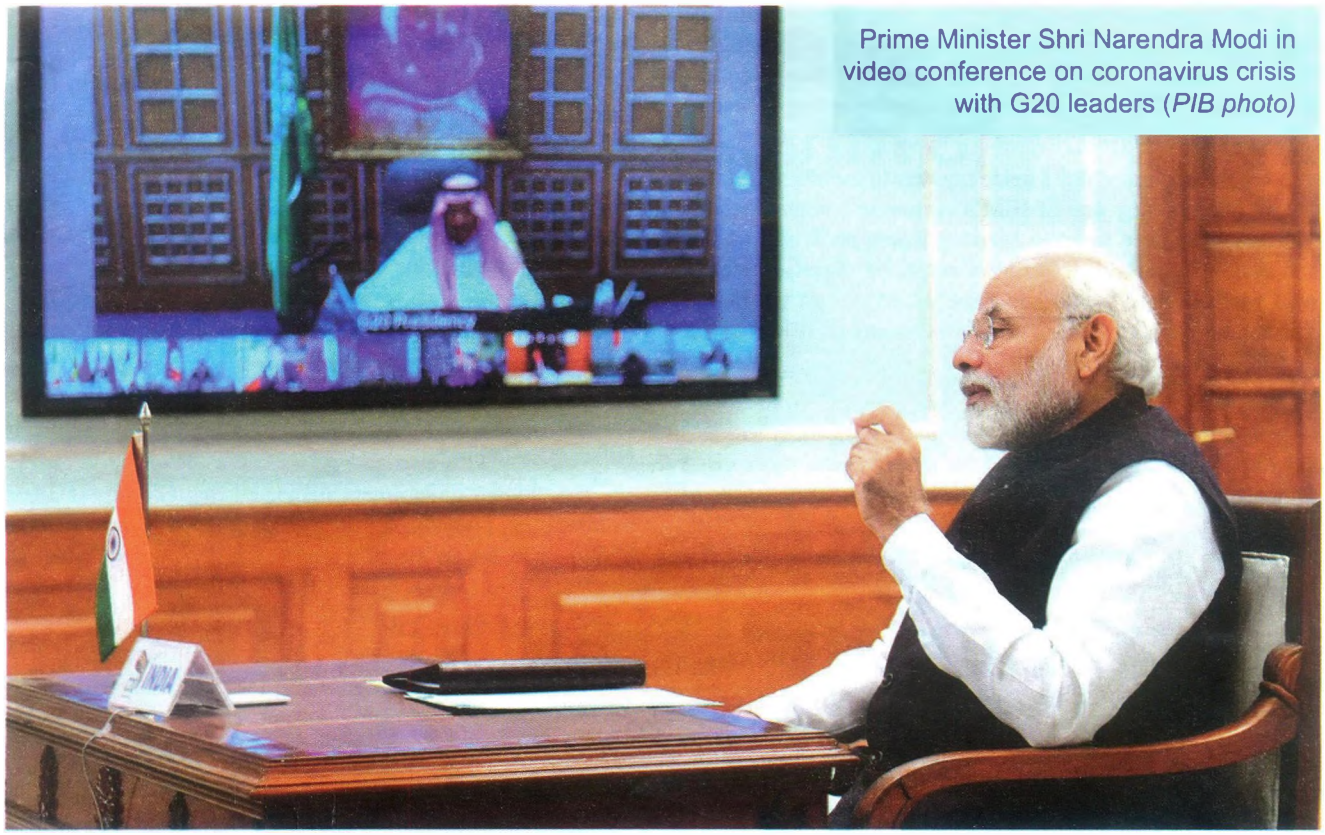
There are over a hundred India-specific e-learning apps, most of them in the form of Android apps. And many lifted their paywalls during the Covid-19 lockdown. The walls will come back once full normalcy is restored – but many parents may see the value of distance learning as a long term investment.

At college and university level, India is fortunate to have in place a platform like SWAYAM which offers hundreds of free MOOC – Massive Online Open Courses – which are recognized for obtaining credit towards degrees by many universities. This has ensured uninterrupted learning to lakhs of students in recent weeks of academic upheaval.



Recording a SWAYAM MOOC course

The other emerging stream of learn from home addresses the mid-career upskilling of professionals, largely in the IT sector where entry-level knowledge can quickly become obsolescent. Leaders like Simplilearn, Edureka, Coursera and Udemy manage to connect tutor to student in times of national disruption – as long as an Internet connection works.



Prime Minister Shri Narendra Modi in video conference on coronavirus crisis with G20 leaders (*PIB photo*)

Extraordinary Virtual G20 Leaders' Summit was convened on March 26 this year, Prime Minister Shri Narendra Modi joined the other leaders from his official home, via video conference.

Since then multiple conferences with senior bureaucrats and state government heads have been conducted with each participant in his or her own home. The central ministries too were able to send almost all their staff home – and still work, thanks to an electronic file movement system called e-Office that has been refined since 2014. With e-files colour coded for priority, the virtual office handles all inter-ministerial traffic, tracks the time taken by each official and highlights inordinate delays. e-Office had already created over 12 million e-files by 2020, so the transition to remote decision making in recent weeks has been smooth.

Prepared or not, remote working became the only viable option across vast sections of Indian enterprise and government, making Work From Home, an idea whose time has come.

Many state governments set a target of 50 percent staff working from home, at all large enterprises. With infotech companies, the number was almost 100 percent with daily teleconferences ensuring smooth client support and contract fulfillment. For some the transition was easier. Said Peter Quinlan, Vice President of Unified Communication and Collaboration at Tata Communications, "For some time now we've had in place flexible working policies – like work from home, flexible working hours, bring-your-own-device (BYOD) and virtual collaboration environments. Our teams are quite comfortable leveraging chat, voice, video and collaboration

Image credit pre:sfoto www.freepik.com

The Gig Economy: When Workers Roam Free

Online payment platforms create a vast unorganised sector of Indian freelance workers

A Gig Economy is a labour market characterised by short-term contracts or freelance work as opposed to permanent jobs. The term "gig" is a slang word meaning "a job for a specified period of time" and was originally used in referring to musicians. Examples of gig employees in the workforce are freelancers, independent contractors and temporary or part-time hires.

In India, it also includes the huge army of delivery persons working with e-commerce sites like Amazon and Flipkart as well as local food and other services like Zomato, Swiggy, Dunzo, etc. None of them works out of an office.

Many who earn a living as freelance professional work from home. They serve a global clientele, commanding an hourly dollar rate that could be anything from $20 to $100. The

Gig economy. One out of four freelance workers worldwide is an Indian

(Image Pixabay)

smartphone has become such a powerful platform for productive apps that many gig workers proudly say: "My phone is my office".

The digital e-commerce platform Payoneer recently brought out a *Freelancer Income Report* which shed new insight on freelancers, their motivations and how this unique workforce empowers global collaboration by connecting top talent with businesses anywhere in the world. The freelance workforce is young, with nearly 70 percent of freelancers under the age of 35, and 21 percent under the age of 25.

Randstad India's 2016 survey on workplace flexibility revealed that 1 in 2 Indian employees prefer telecommuting. Says Bhasker Kode, Founder of Bon, a Pune-based fin-tech company that provides instant credit to many gig workers: "Today, 1 in 4 of freelancers globally is from India. The future of work will include business models where technology will empower the rise of self-employment leading to a greater gig economy."

SHORT FEATURE

Turning Ocean Waters Acidic Threatening Marine Life

Vijai Dharmamony

SEAWATER is salty, and as such one would expect it to be alkaline. Yet, our oceans are becoming more and more acidic. In fact, they are currently 26% more acidic than they were before the world became industrialized, with the rate of acidification increasing faster than we have ever witnessed before.

Atmospheric Carbon Dioxide (CO_2) continues to rise due to anthropogenic CO_2 emissions which are released when fossil fuels are burned. This CO_2 doesn't just waft away into space, some of it remains in the atmosphere where it acts as a greenhouse gas that traps heat, making the planet warmer; and about 30% of it is absorbed by the oceans, where it changes the chemistry of seawater, making it more acidic. Yet, while this does reduce the amount of carbon dioxide in the atmosphere — which is currently 40% higher than it was before the industrial revolution — it is the primary cause of ocean acidification.

There are two other potential causes of acidification: 1) Acidification of coastal waters due to runoff containing nitrogen and phosphates from land-based sources; 2) Release of carbon stored in frozen methane hydrates found in the ocean sediments, which can potentially be released due to ocean warming — a process that would not be reversible.

Oceans Act as Carbon Sink

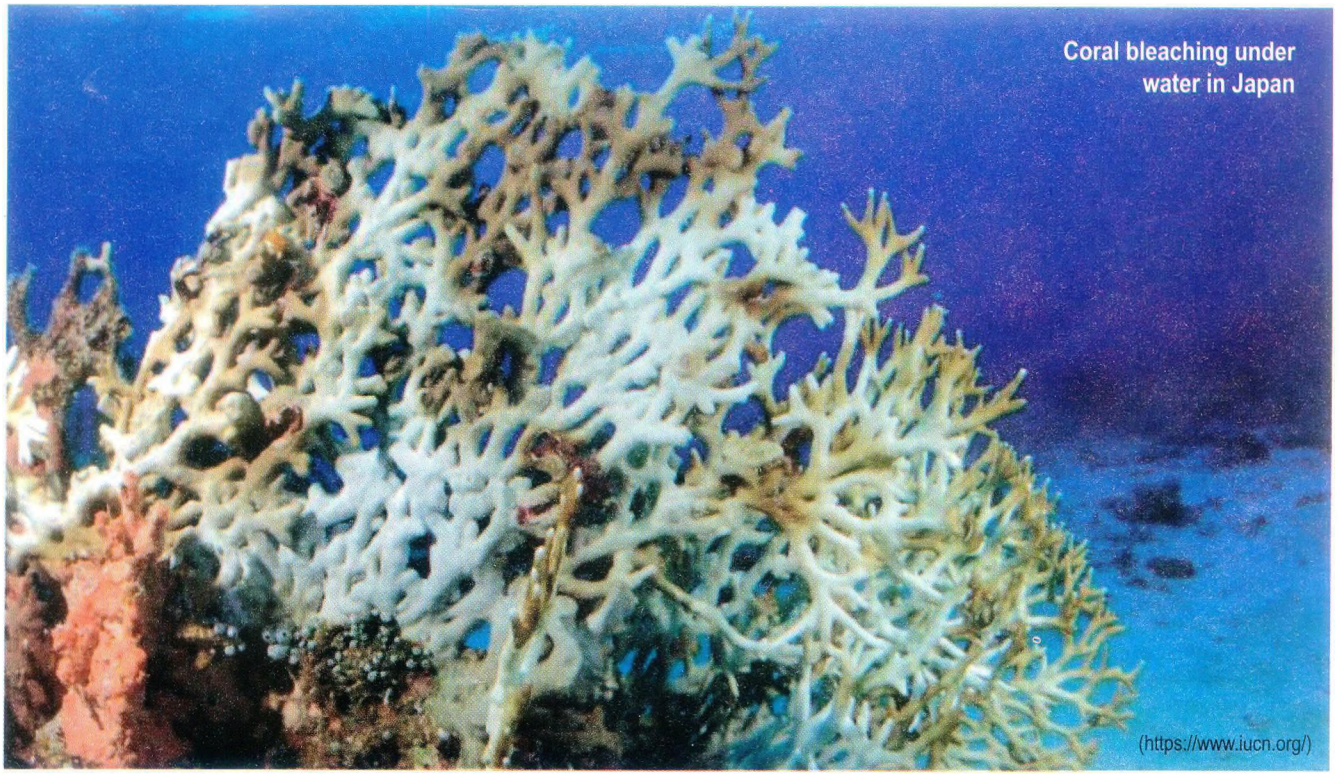
The oceans play a key role in the natural carbon cycle, with carbon dioxide moving from the atmosphere into the oceans across the ocean-atmosphere interface. As carbon dioxide is found in higher concentrations in the atmosphere, it is readily absorbed by the oceans, which traditionally act as a carbon sink.

When carbon dioxide dissolves in seawater it enters the carbonate system where it occurs in one of three forms: dissolved carbon dioxide, carbonate ions (CO_3^{2-}) or bicarbonate ions (HCO_3^-). When carbon dioxide is absorbed into the oceans from the atmosphere it can chemically react with seawater to form carbonic acid (H_2CO_3), which slowly releases hydrogen ions (H^+). Some of these hydrogen ions bond with carbonate ions present in seawater to form bicarbonate.

Consequently, as more and more carbon dioxide is absorbed by the oceans, the concentration of carbonate decreases while the concentrations of hydrogen and bicarbonate increase, resulting in a decrease in pH (potential of hydrogen — the scale used to measure the concentration of hydrogen). The more hydrogen ions are present in seawater (or any solution), the more acidic it is, and therefore the lower the pH.

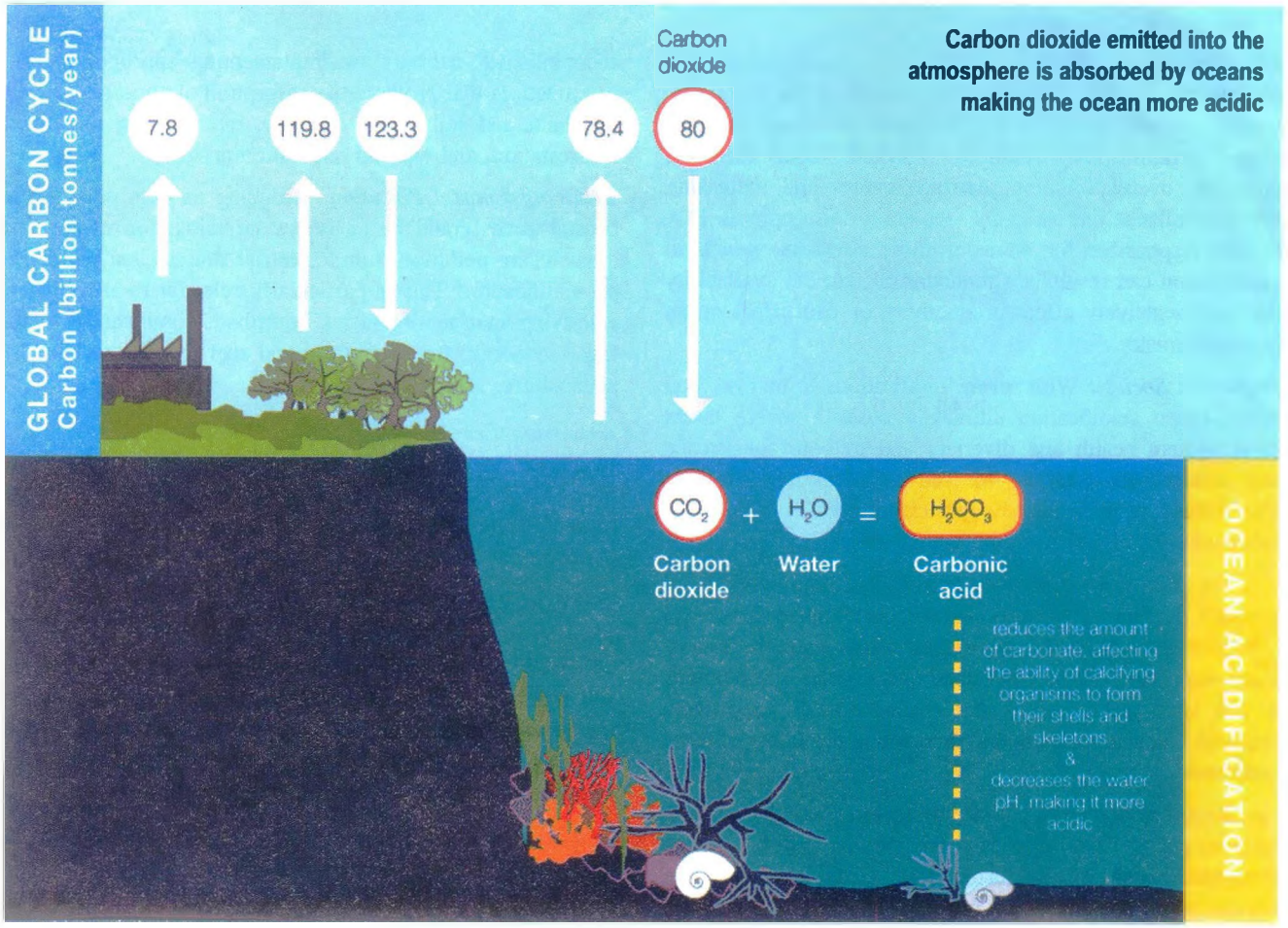
Effects of Ocean Acidification

Impact on Marine Life: Dissolved carbon dioxide is assimilated by phytoplankton during the process of photosynthesis, and carbonate ions (calcium carbonate, $CaCO_3$) are synthesized by zooplankton and other marine organisms, such as snails, shellfish and corals to build shells and skeletons. While high concentrations of CO_2 may be beneficial to photosynthesizing



Coral bleaching under water in Japan

(https://www.iucn.org/)



Source: Adapted from J. Cook, skepticalscience.com.

phytoplankton, fleshy algae and seagrasses if sunlight and nutrients are freely available, it can be detrimental to other marine life.

Carbonic acid can reduce the concentration of calcium carbonate needed by zooplankton and other calcium builders to build and maintain their shells and skeletons. This can affect development, growth, and survival of a wide range of species – from tiny zooplankton to mollusks, coral, urchins and to a lesser degree, even crustaceans such as crabs.

Ocean acidity tends to be higher in the Polar Regions, where important prey species are already being negatively affected. For example, in the Southern Ocean the shells of pteropod snails — which play a key role in marine food webs, supporting the abundant and diverse range of marine life living there — are dissolving. Should a vital prey species such as these be wiped out, it can have spin-off effects that would adversely affect productivity and biodiversity.

As corals are calcifying organisms, coral reefs are also threatened by ocean acidification. Should CO_2 emissions continue to rise, it is highly likely that coral reefs will erode faster than they can be rebuilt. Tropical coral reefs face a double-whammy of erosion due to acidification, as well as bleaching due to ocean warming.

Coral reefs provide essential ecosystem services: they provide food and shelter for a wide range of marine species and are important breeding habitat and nursery grounds for commercial fishery species. They also offer coastal protection from storm surges and are an important source of tourism revenue. Their demise would have substantial ecosystem, economic and social implications.

While ocean acidification may also affect fish physiology, behaviour and health, they are likely to be less affected than calcifying organisms. However, they will be impacted by a reduction in habitat or availability of prey, which could ultimately affect their abundance or survival.

Also, the combined effect of ocean acidification and warmer ocean temperatures has a negative impact on many marine species, reducing the rate of development, growth, and survival. As oceans become more acidic, some species become less tolerant to temperature shifts, while other species become more susceptible to ocean acidification as waters become warmer.

Impact on Marine Ecosystems: With some species, such as phytoplankton and seagrass expected to fare better in acidic waters than others, we are likely to see shifts in the species composition of various marine ecosystems. This will lead to changes in food webs, where predators will have to find alternative food sources in order to survive. Those that are unable to adapt are likely to disappear.

Furthermore, there is a myriad of other stressors that amplify the impacts of ocean acidification, for example, warming ocean temperatures, changes in ocean salinity, ocean stratification, reduced oxygen concentrations, pollution, overexploitation, extreme events and increasing UV-B irradiance due to ozone depletion. Atmospheric CO_2 is also responsible for some of these stressors, which in combination can result in a reduction in nutrient availability that can negatively affect productivity or can affect ocean biogeochemistry.

Impact on Society: With severe implications to marine food webs, ocean acidification ultimately poses a severe threat to ecosystem health and diversity and to both subsistence and commercial fisheries, as well as coral reef tourism. The demise of these income-generating sectors could have substantial social and economic ramifications.

Not only is food security at risk, but employment and people's livelihoods are also at stake. As coral reefs provide coastal zones with protection against rough seas, the loss of these important ecosystems could put coastal communities at risk from storm surges and coastal erosion, negatively impacting local agriculture and threatening the safety of these communities.

Rising acidification could ultimately reduce the amount of atmospheric CO_2 the oceans are able to absorb, causing atmospheric CO_2 to rise further still. Considering that the oceans currently absorb 24 million tons of CO_2 from the atmosphere every day and the rate of acidification is 10 times faster than it's ever been over the last 55 million years, it's clearly an issue that needs to be urgently addressed. But how?

Solutions

A number of mitigating solutions have been proposed to reduce ocean acidification.

Reducing CO_2 Emissions: As anthropogenic CO_2 emissions are the primary cause of ocean acidification, the most realistic and feasible mitigation solution is to reduce the amount of CO_2 in the atmosphere by reducing CO_2 emissions. To achieve this, we ultimately need to reduce the amount of fossil fuels that are burned to produce power.

This would involve action on the part of both the private sector and the industry, as well as individual action. From installing energy efficient gadgets to burning less fossil fuels and opting increasingly for renewable energy sources are some of the options that are being discussed widely in various forums. Green commuting, public transport, group transport, shared-ride schemes, carpooling, bicycling or walking, and even telecommuting can all help reduce the number of vehicles on the road, and thus the amount of CO_2 emitted from those vehicles.

Removing CO_2 from the Atmosphere: While removing CO_2 from the atmosphere using geoengineering methods seems a tad far-fetched and is likely to be expensive, it can easily be accomplished naturally by implementing appropriate land-use practices that promote the absorption of atmospheric CO_2 by plants and soil — for example, tree planting initiatives, reforestation, and wetland restoration programs.

Reducing Coastal Pollution: Reducing nutrient pollution of coastal zones could be an important mitigation measure in areas where pollution from terrestrial sources is a key driver of acidification. This is particularly relevant in areas where calcifying marine organisms contribute significantly to the local economy, for example, coral reef tourism or shellfish aquaculture.

Improving Ecosystem Resilience: While building ecosystem resilience in itself will not reduce ocean acidification, mechanisms such as marine protected areas can serve as tools to help ecosystems become more resilient to the impacts of ocean acidification and other stressors.

Using Additives: The addition of alkaline mineral rocks to the ocean to act as a buffering agent to reduce acidity, as has been used in freshwater lakes, would only be economically feasible and effective in coastal areas on a small scale. Scaling this up for the entire ocean would simply not be effective; nor would it be economically viable. This option could potentially have negative environmental impacts that are still unknown.

Adapting Human Activities: Human activities that depend on the oceans, such as commercial aquaculture and fisheries, may need to adapt to changes in ocean acidity as our knowledge and understanding improve through research. This may lead to affected industries evolving in line with changes and impacts if they wish to survive. For example, hatchery managers can farm species that have a higher tolerance of acidification, they can relocate their operation, or they can limit pumping of water into tanks/ponds when pH levels are not too low.

Reducing Atmospheric Warming: Reducing other greenhouse gases and using geoengineering methods, such as solar irradiation, that target atmospheric warming rather than atmospheric CO_2 are not likely to be beneficial in the short-term. However, they may play a role over larger time scales by preventing carbon stored in methane hydrates from being released into the oceans due to melting hydrates.

While some of the above solutions are indeed creative, the only truly feasible and effective way to reduce atmospheric CO_2 and ultimately ocean acidification is to reduce the amount of CO_2 emitted into the atmosphere in the first place. The most effective way to do this would be to replace dirty fossil fuels with cleaner sources of energy. The technology is available, we just need the political will to push ahead with this.

Dr Vijai Dharmamony is Outreach Communications Officer, National Centre of Biological Sciences (NCBS), Tata Institute of Fundamental Research (TIFR), Bangalore Life Sciences Cluster (BLiSC) Campus, Bellary Road, GKVK, Bangalore-560065. Email: vijaid@ccamp.res.in

FEATURE ARTICLE

Aditya-L1: First Indian Mission to Study the Sun

Anand Kumar Sharma

INDIA'S first spacecraft for exclusive studies on the Sun is scheduled for launch this year. Aditya-L1 spacecraft will orbit around the Sun–Earth Lagrangian point 1 (L1), about 1.5 million kilometres from the Earth, carrying seven payloads to observe the photosphere, chromosphere and corona of the Sun in different wavebands.

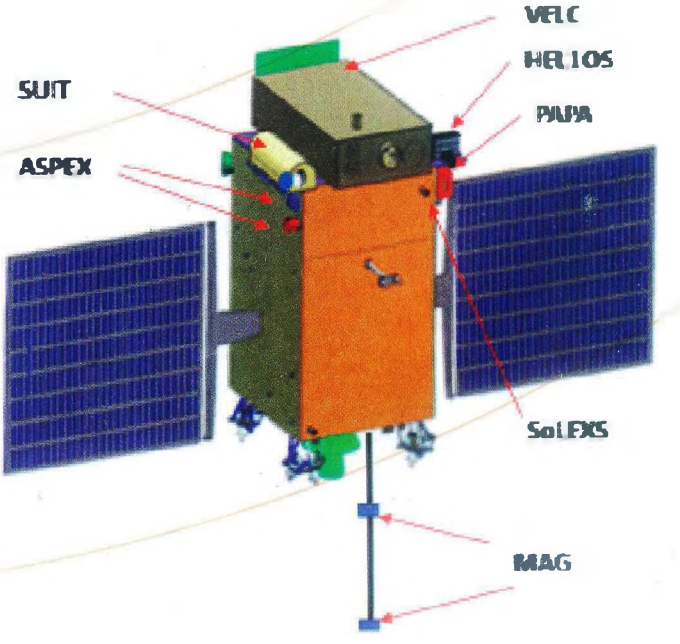
The Aditya-L1 mission was conceptualised in January 2008 as a small 400 kg, 800 km low-Earth orbit Sun synchronous satellite with a coronagraph (Visible Emission Line Coronagraph, VELC) to observe only the solar corona. The corona is the outer layer of the sun extending to thousands of kilometres above the disc (photosphere), which we see during a full solar eclipse. It has a temperature of more than a million Kelvin which is much higher than the solar disc temperature of around 6000 K. How the corona gets heated to such high temperatures is still an unanswered question in solar physics.

The scope of the mission has since been expanded. The spacecraft will be inserted in a halo orbit around the L1 point, where it will act as a comprehensive solar observatory studying coronal heating, solar wind acceleration, coronal magnetometry, origin and monitoring of near-UV solar radiation (which drives Earth's upper atmospheric dynamics and global climate), coupling of the solar photosphere to chromosphere and corona, in-situ characterisations of the space environment around Earth by measuring energetic particle fluxes and magnetic fields of the solar wind and solar magnetic storms.

The payloads used for these studies have to be placed outside the interference from the Earth's magnetic field and could not have been useful in the low earth orbit.

Exploring the Sun

The Sun has been studied in great detail, but still there are many unanswered mysteries. How is the corona heated to more than a million degrees? Where and how does the solar wind obtain its acceleration? Which processes in the lower corona lead to the gigantic mass ejections? What are the sources that heat the chromosphere, the transition region and the solar corona, above the much cooler photosphere?



Mission Objectives of Aditya-L1

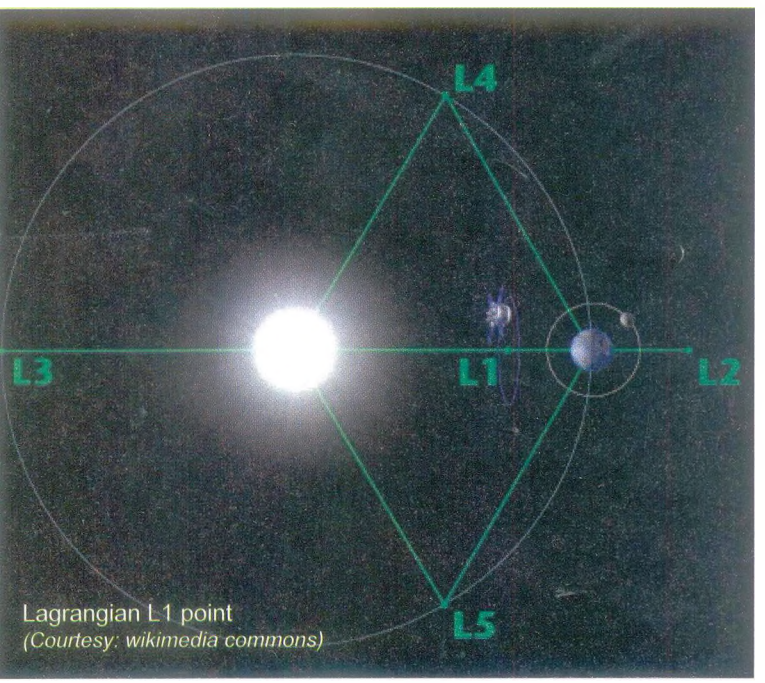
- Understanding the coronal heating and solar wind acceleration.
- Understanding initiation of coronal mass ejection, flares and near-earth space weather.
- Knowledge of coupling and dynamics of the solar atmosphere.
- Understanding solar wind distribution and temperature anisotropy.

The eruptive phenomena of flares and Coronal Mass Ejections (CMEs) which expel huge amounts of particulate matter and energy have direct consequences on space weather. How exactly the Sun's radiation affects the dynamics of the Earth's atmosphere on shorter as well as on longer time scale is yet to be comprehended.

To understand some of these mysteries, Aditya-L1 is planned with a suite of instruments to obtain a better understanding of the star. The extended scope of the mission with additional payloads demanded a larger satellite platform. The 1,500 kg Aditya-L1 now carries seven science payloads. The nominal design life of spacecraft is five years.

Lagrange Points: Parking Places in Space

A Lagrangian point is a location in space near two large bodies where a smaller object will maintain its position relative to the large orbiting bodies. It is a location in space where the combined gravitational forces of two large bodies, such as Earth and the Sun or Earth and the moon, equal the centrifugal force felt by a much smaller third body (e.g. artificial satellite). At other locations, a small object would go into its own orbit around one of the large bodies.



Lagrangian L1 point
(Courtesy: wikimedia commons)

In the Sun–Earth system, the Lagrange points are special locations where an artificial satellite will stay stationary relative to the Earth. At these locations, the pull of gravity from the Earth cancels out the pull of gravity from the Sun. Anything placed at these points will feel equally pulled toward the Earth and the Sun and will revolve with the Earth around the Sun.

Many astronomical and Earth observatories are located at the Lagrange points, providing a vantage point of our planet and space. L1 point gets an uninterrupted view of the Sun and therefore is a good position to monitor the Sun. The constant stream of particles from the Sun, the solar wind, reaches L1 point about an hour before reaching the Earth.

L1 point is currently occupied by the Solar and Heliospheric Observatory (SOHO-1995), the ESA/NASA solar watchdog and the NASA/NOAA Deep Space Climate Observatory (2015). There are many satellites carrying particle experiments at L1, like NASA's spacecraft Wind (1994) and ACE (Advanced Composition Explorer-1997), and NOAA's Deep Space Climate Observatory (DSCOVR-2015).

Payloads

Aditya-L1 has seven payloads – two imaging telescopes (VELC and SUIT), two X-ray instruments (SoLEXS and HEL1OS), two particle instruments (PAPA and ASPEX) and an advanced digital magnetometer (MAG).

i. **Visible Emission Line Coronagraph (VELC):** VELC the main payload on-board Aditya-L1 to study the solar corona in three visible and one infra-red bands. The coronagraph mimics total solar eclipse by blocking the sunlight with an occultor and enabling the observation of extended coronal atmosphere of the Sun. VELC is capable of simultaneous imaging, spectroscopy and spectro-polarimetry close to the solar limb.

ii. **Solar Ultraviolet Imaging Telescope (SUIT):** The primary goal of SUIT instrument is to understand how the solar atmosphere is energized. The instrument developed at the Inter-University Centre for Astronomy and Astrophysics (IUCAA) in collaboration with ISRO and other institutes weighs nearly 35 kg.

This instrument will measure the solar eruptive events up to 1.1 solar radii in the near ultraviolet wavelength range (200–400 nm). The Sun has never been observed from space in this wavelength range.

SUIT will simultaneously map the photosphere and chromosphere of the Sun providing full disk images of different layers of the solar atmosphere and also study solar irradiance variations which are closely connected with magnetic activity on the solar disc.

iii. **High Energy L1 Orbiting X-ray Spectrometer (HEL1OS):** HEL1OS will observe the dynamic events in the solar corona and provide an estimate of the energy used to accelerate the solar energetic particles during the eruptive events. This payload has been developed by U.R. Rao Satellite Centre (URSC), Udaipur Solar Observatory (USO) and Physical Research Laboratory (PRL).

iv. **Solar Low Energy X-ray Spectrometer (SoLEXS):** SoLEXS will monitor the X-ray flares for studying the enigmatic coronal heating mechanism of the solar corona. SoLEXS instrument has been developed at the U.R. Rao Satellite Centre (URSC).

v. **Plasma Analyser Package for Aditya (PAPA):** PAPA instrument is designed to understand the composition of solar wind and its energy distribution. This payload has been developed by Space Physics Laboratory (SPL), VSSC.

vi. **Aditya Solar wind Particle Experiment (ASPEX):** ASPEX will study the variation and properties of the solar wind as well as its distribution and spectral characteristics. This instrument was developed at the Physical Research Laboratory (PRL).

vii. **Advanced Triaxial High Resolution Digital Magnetometer (MAG):** This instrument will measure the magnitude and nature of the interplanetary magnetic field (IMF) and has been developed by Laboratory for Electro-optic Systems (LEOS) and U.R. Rao Satellite Centre (URSC).

Launch and Operations

Aditya-L1 is expected to be launched during the first half of 2020 by the Polar Satellite Launch Vehicle XL version (PSLV-XL) from Sriharikota. XL version has six extended length (XL) strap-on motors. The satellite will be launched into an elliptical Earth Parking Orbit of 245 km by 21,000 km. The satellite propulsion is employed to carry out orbit manoeuvres to raise the orbit, transfer around the L1 point, insertion and maintain orbit about L1. The orbit period of the spacecraft is 177.86 days.

The insertion around L1 will take place in about 100 days from the launch (coast phase). Aditya-L1 is expected to provide the very first results of the magnetic field of the Sun's corona almost two months after the launch.

The ISRO Telemetry Tracking and Command Network (ISTRAC) will track and control the spacecraft. For the initial phase operations, additional network stations from other agencies will also be utilized. The payload data will be acquired through Indian Deep Space Network (IDSN). These data will be processed and disseminated through the Indian Space Science Data Centre (ISSDC).

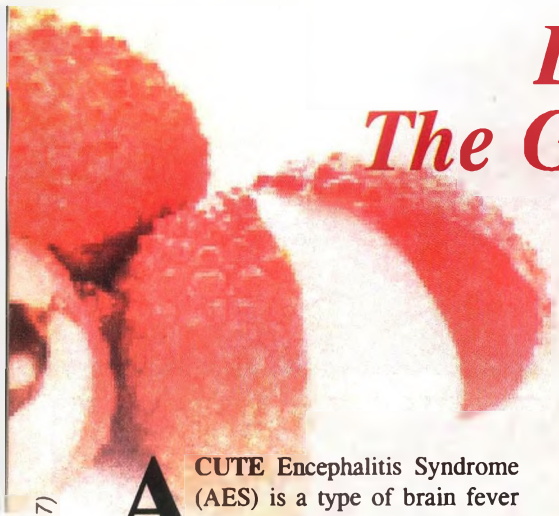
Aditya-L1 is the first Indian mission to study the Sun and the first venture of the country to place a spacecraft into the halo orbit at the Lagrangian point. It is expected to provide a multipronged holistic approach to the understanding of some of the outstanding problems of solar physics. The spacecraft will provide the observations of Sun's Corona (soft and hard X-ray, emission lines in the visible and NIR), chromosphere (UV) and photosphere (broadband filters).

VELC instrument will enable the study of the dynamics at the corona. The SUIT payload will study the intensity enhancement at the chromospheric layers. The SoLEXS and the HEL1OS instruments will provide observations on the initiation of the impulsive phase of the flares. This combination of measurements will help in providing a comprehensive picture of the solar eruptive events and help fine-tune models providing a physical understanding of these events, and hence the drivers affecting space weather.

In addition, particle payloads (PAPA, ASPEX) will measure the particle flux emanating from the Sun and reaching the L1 orbit, and the magnetometer payload will measure the variation in magnetic field strength at the halo orbit around L1.

The mission will be a significant milestone for the Indian space programme in that it will not only provide valuable solar science data to Indian scientists but will also benefit the global scientific community in understanding the sun.

Dr. Anand Kumar Sharma is Former Distinguished Scientist, ISRO. Address: Anukampa, No. 14-15, 1 Main, 2 Cross, Sri Veerbhadra Nagar (Basava Nagar), Marathahalli Post, Bangalore-560037, Karnataka. Email: anukampa2003@yahoo.com



Lychee Fruit: The Good, the Bad and the Ugly

Aditya Rao SJ

Image source: Britannica Encyclopedia (2007)

ACUTE Encephalitis Syndrome (AES) is a type of brain fever where a part of the brain becomes inflamed and the symptoms appear to be similar to fever. Though lychee fruits are consumed throughout the world due to their rich chemical composition and nutraceutical properties, in the past decade several speculations have come out connecting AES to the consumption of lychee fruit, mainly by children below 10 years of age, leading to fatal outcomes.

Lychee (litchi) is a tropical tree belonging to the *Sapindaceae* or soapberry family which consists of over 2,000 species and 150 genera. It is a medium-sized tree that can grow up to 40 to 50 feet in height. Lychee can also be grown as a source of food and even for ornamental purposes.

Growth and Export

The total production of lychee worldwide was estimated to be around 2.11 million tons, of which more than 95% of the production area is shared by Asian countries majorly China, India, Taiwan, Thailand and Vietnam. China and India together account for 91% of the world's total lychee production as well as productivity.

In India due to soil and climatic limitations, lychee production is limited to Bihar, Tripura, West Bengal, Uttar Pradesh, Punjab and Haryana states among which Bihar dominates with 44.5% of the total lychee production in India.

India being the second-largest producer in the world next to China, fruits like mango and grapes still dominate the domestic and export trade. Though lychee is widely grown, it still has many unexplored potentials in both domestic and global market. As it has high demand in the Middle East countries, an appropriate boost to its foreign export can generate a remarkable economic gain.

Health Benefits

Studies have suggested that a low molecular weight polyphenol called oligonol is abundantly found in lychee fruits and is responsible for its antioxidant and anti-influenza virus activity.

Like citrus fruits, lychee is also a good source of vitamin C, consumption of which helps the human body to develop resistance against several infectious agents. It is also a good source of vitamin B-complex and many minerals like potassium and copper which have a major role in controlling heart-related problems.

Apart from the lychee fruit, its peel and seeds have also attracted attention due to the presence of many beneficial substances that exhibit antioxidant, cancer preventive, antimicrobial, and anti-inflammatory effects.

Lychee fruit contains a high amount of carbohydrates and fibres and low amounts of lipids and proteins (Table 1). Several reports have shown a series of health benefits of lychee fruits including antioxidant, cancer preventive, antimicrobial, anti-inflammatory activities, and so on.

Taxonomical classification

Kingdom: Plantae
Clade: Angiosperms
Clade: Eudicots
Clade: Rosids
Order: Sapindales
Family: Sapindaceae
Subfamily: Sapindoideae
Genus: *Litchi*
Species: *L. chinensis*
Binomial name: *Litchi chinensis*

Association with Health Complications

Lately, lychee fruit has become associated with some health complications associated with its consumption which have even led to death. Recent researches have mentioned the presence of a chemical methylene cyclopropyl glycine in lychee fruits which can cause hypoglycemia (abnormally low blood sugar). Its consumption was also associated with encephalopathy (disorder or disease of the brain) also known as *chamki bukhar* in local language from patients majorly residing in the Northern part of India.

Deaths due to the consumption of lychee fruits have been reported regularly in India especially in Bihar and West Bengal. The affected individuals mainly belong to the age group of less than 10 years.

These outbreaks are suspected to be associated with Acute Encephalitis Syndrome (AES) or Japanese Encephalitis (JE) commonly referred to as brain fever. Early symptoms of

Reported Deaths due to lychee fruit consumption in India

2013 - 143

2014- 355

2015 - 11

2016 - 04

2017 - 11

2018 - 07

2019- 152

Since 2010, 1,350 children have died in Muzaffarpur of Bihar due to suspected AES.

Source: National Centre for Disease Control (NCDC).

Table 1: Major nutrient composition in Lychee fruit (Source: USDA, 2019)

Nutrition		% Daily Value	Nutrition	% Daily Value
Total Fat	0.4 g	0%	Vitamin A	0%
Saturated fat	0.1 g	0%	Calcium	0%
Polyunsaturated fat	0.1 g		Vitamin D	0%
Monounsaturated fat	0.1 g		Cobalamin	0%
Cholesterol	0 mg	0%	Vitamin C	119%
Sodium	1 mg	0%	Iron	1%
Potassium	171 mg	4%	Vitamin B-6	5%
Carbohydrate	17 g	5%	Magnesium	2%
Dietary fiber	1.3 g	5%	Per cent Daily Values are based on a 2,000 calorie diet	
Sugar	15 g			
Protein	0.8 g	1%		

AES are visible within a few minutes to hours which can be similar to those of flu, with high temperature or headache. With delay in taking treatment measures, the symptoms may worsen leading to seizures, paralysis and even coma.

The cause may be associated with the ingestion of phytotoxins present in lychee fruit, specifically alpha-(methylene cyclopropyl) glycine, the lower homologue of the neurotoxic L-amino acid hypoglycin. Apart from AES, anaphylactic reactions have also been reported after the consumption of lychee fruit. Anaphylaxis is a serious allergic reaction that is rapid in onset and may lead to death.

The consumption of lychee fruits has also been linked to hypoglycemia. The fruits and seeds contain hypoglycin A and Methylene Cyclopropyl-glycin (MCPG), compounds that inhibit the synthesis of glucose and can cause acute hypoglycemia. These chemicals are found in higher concentration in unripe fruits, and their effects seem to be compounded in undernourished children or when consumed after a period of fasting.

Asthana and team made a study on the effect of ingestion of the lychee seeds and reported a dose-dependent toxic hypoglycemic encephalopathy in undernourished children in Muzaffarpur, Bihar. A case-control study reported in the journal *The Lancet* justified the significant epidemiological association between lychee consumption and illness and ruled out the role of infectious pathogen, pesticide, and heavy metal relating to the cause of illness suggesting that routinely washing fruit or vegetables was not directly related to a toxin or infectious agent.

Preventive Measures

The most appropriate preventive measure is providing safe drinking water and proper sanitation facilities. There is also a need to improve the nutritional status of children at risk of JE/AES.

As per Govt of India guidelines, two doses of JE vaccines are to be given with UIP and measles vaccines to children below 9 months and the next dose with DPT booster at the age of 16-24 months.

The National Family Health Survey (2015-16) states almost half of the children fewer than five in Bihar, particularly Muzaffarpur, are stunted, almost 60 per cent are anaemic, and more than 40 per cent are underweight. It is well known that Acute Encephalitis Syndrome (AES) appears in a population consisting of undernourished children who are already having a deficiency of sugar in their body. Consumption of unripe or semi-ripe lychee pulp along with seeds by such undernourished children worsened the situation resulting into acute hypoglycemic encephalopathy.

The scientific panel on sampling and analysis at FSSAI (Food Safety and Standards Authority of India) suggested that the hypoglycemia or low blood sugar is due to the natural toxins present in unripe lychee fruits and can be a contributing factor for these deaths. The toxins reduce or even disappear on the maturation of the fruit.

Though lychee being hypoglycemic, its consumption by adults does not cause serious health problems due to the presence of abundant glucose reserves but consumption by glucose-deficient children will further deplete the leftover sugar and sustenance of such hypoglycemic state followed by extended sleep during the night becomes fatal for children. So, even though lychee fruit has enormous health benefits, its consumption with lower sugar content in the body may lead to serious health complications sometimes even leading to death.

Acknowledgement

The author thanks Director, CSIR-CFTRI; Dr Ramesh SR, Professor (Retd.), Department of Studies in Zoology, University of Mysore; and Dr Nandini P. Shetty, Principal Scientist, CSIR-CFTRI, Mysuru for their support. The author also thanks DST-SERB for extending their support for the project: PDF/2018/00237

Dr Aditya Rao SJ, National Post Doctoral Fellow (SERB-NPDF), Dept of Plant Cell Biotechnology, CSIR-Central Food Technological Research Institute (CFTRI), Mysuru-570020, Karnataka. Email: aditya.rf0945@cftri.res.in

CSIR TECHNOLOGY SHOWCASE

"3D-Printed Patient-Specific Medical Implants"

Meher Wan

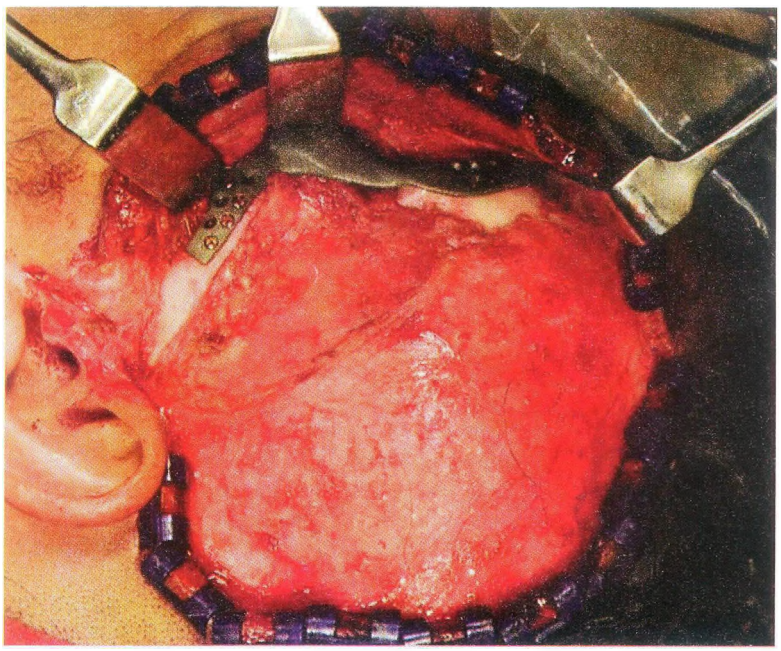
SCIENTISTS of the CSIR-Central Scientific Instruments Organisation (CSIO), Chandigarh, have developed a technology for manufacturing patient-specific medical implants for several human body parts. The technology has been recently transferred to industry for commercial production and marketing of the product.

Although, medical implants of biocompatible metals are now common in cases of fractured bone surgeries, due to the very complex anatomy of the human body surgeons have to face extreme challenges in reconstructive surgeries. Implants made with common specifications don't fit well in different patients. Patient-specific implants are required in trauma, diseases like cancer, fungal infection or other reconstructive surgeries for specifically targeted patients. Patient-specific implants are also required in the case of unavailability of implants for specific sites of the human body or when available implants do not fulfil the anatomical requirement of a patient. Researchers worldwide are in a race to make patient-specific implants.

Scientists at CSIR-CSIO have attempted to solve this complex problem with the help of Computer-Aided Design (CAD) followed by 3D printing of the biocompatible metals. In this process, the patient's CT-Scan/MRI data is utilised to design the implant with specifications compatible to patients.

The CT-Scan/MRI data is used to generate the 3D CAD model of the anatomic site where the surgery is to be performed. According to the CT-Scan or MRI data, the surgeons remove the infected volume from the human body. After removal of tissue lesion, the 3D model of the void is prepared using CAD modelling software taking care of fitting and functionality of the implant. This CAD model is converted into a 3D part using 3D printing process.

3D printing of metal involves melting the metal powder with the help of high power lasers. Different metals have different melting temperatures. Titanium is the preferred metal for implants because of its biocompatibility. Different titanium alloys are now used due to their



Coronavirus Dis

Advice for the Public:

From the evidence so far, the new coronavirus can be transmitted in ALL AREAS, including areas with hot and humid weather.
Regardless of climate, adopt protective measures if you live in, or travel to an area reporting COVID-19.
The best way to protect yourself against COVID-19 is by frequently cleaning your hands. Eliminate viruses that may be on your hands and avoid infection that could occur by then touching your eyes, mouth, and nose.

FACT:
The new coronavirus can be transmitted in areas with hot and humid climates

World Health Organization #Coronavirus #COVID19

Taking a hot bath will not prevent you from catching COVID-19. Your normal body temperature remains around 36.5°C to 37°C, regardless of the temperature of your bath or shower. Actually, taking a hot bath with extremely hot water can be harmful, as it can burn you.
The best way to protect yourself against COVID-19 is by frequently cleaning your hands. By doing this you eliminate viruses that may be on your hands and avoid infection that could occur by then touching your eyes, mouth, and nose.

FACT:
Taking a hot bath does not prevent the new coronavirus disease

World Health Organization #Coronavirus #COVID19

No. There is no evidence that regularly rinsing the nose with saline has protected people from infection with the new coronavirus.
There is some limited evidence that regularly rinsing nose with saline can help people recover more quickly from the common cold. However, regularly rinsing the nose has not been shown to prevent respiratory infections.

Can regularly rinsing your nose with saline help prevent infection with the new coronavirus?

World Health Organization #2019nCoV

Thermal scanners are effective in detecting people who have developed a fever (i.e. have a higher than normal body temperature) because of infection with the new coronavirus. However, they cannot detect people who are infected but are not yet sick with fever. This is because it takes between 2 and 10 days before people who are infected become sick and develop a fever.

How effective are thermal scanners in detecting people infected with the new coronavirus?

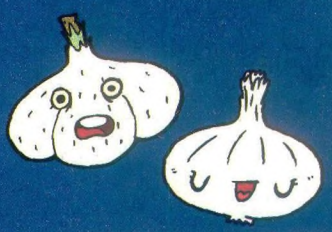
World Health Organization #2019nCoV

ease (COVID-19)

Myth Busters

Can eating garlic help prevent infection with the new coronavirus?

Garlic is a healthy food that may have some antimicrobial properties. However, there is no evidence from the current outbreak that eating garlic has protected people from the new coronavirus (2019-nCoV).



World Health Organization

#2019nCoV

Does the new coronavirus affect older people, or are younger people also susceptible?

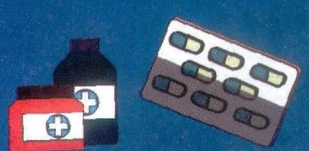
People of all ages can be infected by the new coronavirus (2019-nCoV). Older people, and people with pre-existing medical conditions (such as asthma, diabetes, heart disease) appear to be more vulnerable to becoming severely ill with the virus. WHO advise people of all age to take steps to protect themselves from the virus, for example by following good hand hygiene and good respiratory hygiene.

World Health Organization

#Coronavirus

Are antibiotics effective in preventing and treating the new coronavirus?

No, antibiotics do not work against viruses, only bacteria.
The new coronavirus (2019-nCoV) is a virus and, therefore, antibiotics should not be used as a means of prevention or treatment.
However, if you are hospitalized for the 2019-nCoV, you may receive antibiotics because bacterial co-infection is possible.



World Health Organization

#Coronavirus

Are there any specific medicines to prevent or treat the new coronavirus?

To date, there is no specific medicine recommended to prevent or treat the new coronavirus (2019-nCoV). However, those infected with the virus should receive appropriate care to relieve and treat symptoms, and those with severe illness should receive optimized supportive care. Some specific treatments are under investigation, and will be tested through clinical trials. WHO is helping to accelerate research and development efforts with a range or partners.

World Health Organization

#Coronavirus

If you aim for the sky there is no limit!

MINNIE VAID has juggled multiple roles over a three decade stint in mainstream media. She is a print and television journalist, a documentary filmmaker, creative producer and author of four non-fiction books including *Those Magnificent Women and Their Flying Machines: ISRO's Mission to Mars* (2019). Her areas of interest include social and political issues in rural India, human rights, the environment and gender.

Her latest non-fiction novel (*Those Magnificent Women and Their Flying Machines: ISRO's Mission to Mars*) throws light on the lives and odysseys of women scientists and engineers of ISRO involved in MOM (Mars Orbiter Mission) and other missions.

In an e-mail interview, she talks to **VRITANT KUMAR** about her latest non-fiction science novel, her interactions with women scientists and their grit and determination in face of all hardships.

Vritant Kumar: ***Please tell us something about your life, your childhood and the moment you decided to make your way in journalism?***

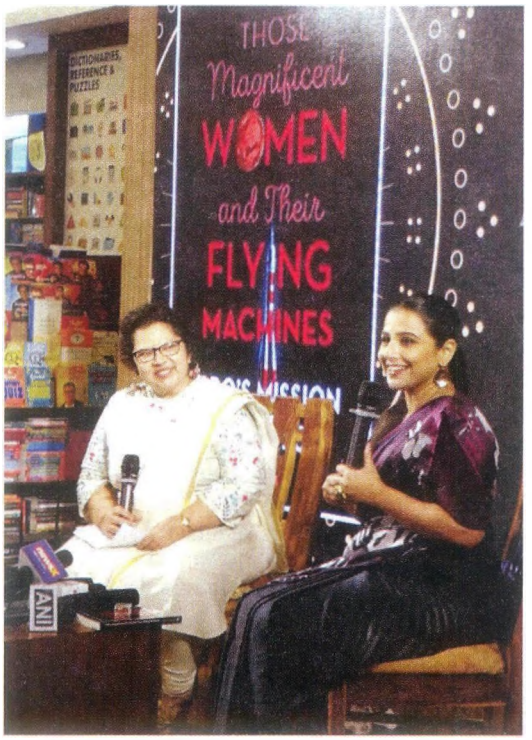
Minnie Vaid: I did my school and college from Pune – St Josephs Convent of Jesus & Mary and Political Science Honours from Fergusson College. I then went to Mumbai for post graduation at the Sophia Polytechnic in mass communications.

VK: ***Why did you choose the field of journalism?***

Minnie Vaid: I had an innate sense of curiosity always as a child…plus I wrote well even in class 10…so my teachers encouraged me to choose my own path which I did and which was none other than journalism.

VK: ***Apart from a journalist, you are also a documentary filmmaker, creative producer and author of four non-fiction books. Please tell us something about your professional journey.***

Minnie Vaid: I left Sophia Polytechnic to carve out my career for the next 20 years. Those years were spent doing jobs



Minnie Vaid with actress Vidya Balan at the launch ceremony of her novel *Those Magnificent Women and their Flying Machine: ISRO's Mission to Mars*

in print and then television media as a journalist, in organisations such as the *Times of India*, *Illustrated Weekly*, *Imprint* and *News Track*... this was mostly political and social journalism, nuts and bolts stories and politicians and election coverage, etc. All this was very exciting stuff but I think I really came into my own with producing and directing *Roots* for Business India Television... it was a one-hour programme on issues in rural India in 1994. Nobody had covered rural India then, very few do even now; it's a huge pity that BITV didn't survive to allow me to tell more stories. Rural India remains an abiding interest and in fact almost all of my documentaries are set there.

Star Plus where I spent three years making more friends than television programmes — was interesting. But when the *saas and bahu* serials entered Star Plus I knew it was time to say goodbye.

When I started working for myself as a freelance documentary film maker, I did the work that I feel SCM laid the foundations for...pursuing a social conscience through my films, later also through my books.

My work has a running thread of injustice and how it affects people... so I would always get attracted by topics such as whistleblower Satyendra Dubey, killed for speaking out against corruption or Dr Binayak Sen, pediatrician and rights activist who spent 30 years helping tribals in Chhattisgarh. Coincidentally, this leads to my also writing my first book on Binayak Sen followed by a short one on another rights activist, Irom Sharmila. A little later the women of Kudankulam, fighting against having a nuclear power plant in their backyard, were the heroes of my third book When I asked them how they planned to survive against the might of the state they gave an answer that became the title of my book, *The Ant in the Ear of the Elephant*.

VK: ***How did you decide to write a book on the Mars Orbiter Mission (MOM) and exclusively about the women scientists involved in the Mission?***

Minnie Vaid: I was attending a women empowerment summit and three of the Mars mission women scientists of ISRO were speaking there...one of them said, "We worked on the mission in the day and in the night, we took care of our families and children and somewhere we also launched a rocket into space..." It was such a throwaway remark, said with such casual confidence — like the Tata Steel catchline, *We also make steel* – that I was hooked.

This book on the ISRO women scientists has perhaps been my most popular work so far...it profiles the incredible story of women scientists of the Mars mission and other missions...how these women work in significant roles in ISRO, Ritu Karidhal for example who was the deputy operations director in Mangalyaan was the mission director of Chandrayaan 2...all of these women come from conservative modest backgrounds, many from second-tier cities, having fought with fathers to get to ISRO, and going on to do stellar work, while balancing families and children.

VK: ***What were some of the stellar qualities you noticed in the women scientists at ISRO?***

Minnie Vaid: The women were all really nice and warm, shared their stories, told them in simple language that a non science person like me could understand. I was really impressed by how humble they were, also how calm and collected under tremendous pressure to deliver...space is a very tough environment to work in and they were superb in their work.

VK: ***Please also tell us about some challenges and difficulties you faced in your life and how you confronted them?***

Minnie Vaid: I did not face any real gender problems in my 30 year career in media as in media women rule! I had women bosses most of the time...the challenges were the usual ones related to work-life balance. I actually ended up focusing a lot more on the work part instead of life and that is one regret I have.

VK: ***What message would you like to give the students and the young?***

Minnie Vaid: Dream big, don't get limited by any dogmas or prevailing social beliefs. If you aim for the sky there is no limit! At least for this generation, the sky will not be the limit.

Vritant Kumar is a student of class 8 with a passion for science and literature. Address: H/no-14, R/no-3A, Mahesh Nagar, Patna-800024, Patna, Bihar. Email: vritant.kumar@yahoo.com

Communication Beneath the Waves

How do marine animals communicate in the often dark and vast featureless oceans?

Gobardhan Sahoo

HUMAN beings have a well-developed language having scripts and phonetics for communication purposes. We also sense our surroundings by mostly visual and auditory input. But how do marine organisms communicate with each other and sense their surroundings in a vast featureless ocean?

This is mainly achieved by either employing a single type of signal consisting of visual, acoustic, chemical, magnetic, electrical and bioluminescent signal or a combination of two or more types of signals to locate food, mate, habitat, and even to avoid predators.

Visual Signals

Fishes, dolphins, whales and other invertebrates such as crabs and shrimps rely on their eyes to communicate effectively in the vast ocean during the daytime. Even sea birds like gannets, grebes, loons, cormorants, and penguins use their vision to catch fishes underwater.

The eyes of all these animals possess two types of cells called rods and cones within the retina. The rods help in visualising in low light conditions whereas cones remain active in high light conditions and are useful in colour vision.

Additionally, some animals such as dolphins have a reflective layer behind the retina, called tapete lucidum, which helps them to see their environment in low light deeper waters by reflecting lost light back into the retina for the second time. The information received by the eye is converted into a visual image by the brain of the receiver in real-time, and the desired objectives (recognising the relatives, predators or food) are carried out.

The limitations of this signal are: (a) it is not receiver specific and (b) is effective during day-time and in the euphotic zone (light penetration depth ~ 100m) only. Even in the euphotic zone where light is available, visibility is still comparatively much less than that in the air; because water is a denser medium and often bears sediment particles which further attenuate the light intensity.

Acoustic Signals

Marine mammals such as whales and dolphins are notable examples using acoustic signals (sound) for the acquisition of information from the environment. Aristotle (384 to 322 B.C.) was the first biologist who described in his famous book *Historia Animalium* that dolphins are capable of listening to underwater sounds. The marine mammals using short pulses of sound or clicks can detect food, obstacles, and even their relatives after listening to the echoes.

Sound production is also known in case of fishes for a mating call between male and female individuals of a species. For example, males of oyster toadfish emit a series of short-duration sounds to attract females during the breeding season. The seawater medium being denser than air propagates the sound to far off distances from the source (speed of sound: air ~ 330 m/s and seawater ~ 1500 m/s) making sound quite helpful as a signal for the communication purpose.

Due to the fast propagation of sound in seawater, baleen whales in the ocean can receive the signaling sound produced by their own relatives far beyond even from a distance of around 10 kilometres where visual signals cannot be used for the acquisition of information. But the production of sound

A pufferfish (with eye zoomed) from the coral reefs of Andaman and Nicobar Islands, India. *Courtesy: Titus Immanuel, Madras Christian College, Chennai, India*

An oyster toadfish
Photo from NOAA, *Credit: Andrew David, NOAA/NMFS/SEFSC Panama City; Lance Horn, UNCW/NURC — Phantom II ROV operator*

Communication by marine mammals using sound
Image Source: https://blog.nationalgeographic.org

by organisms is energetically costly, and hence switching to different mode at times is always advantageous in the marine environment.

Chemical Signals

Just imagine you are roaming in a big city with perpetual darkness on a hungry stomach. How will you find out your food? Obviously, it is the smell of food which will attract you towards a restaurant. This smell is nothing but volatile chemicals emanating from the cooked food.

Similarly, organisms living in the marine environment (especially deep sea) depend upon chemical signals to get information about their food, mate, habitat, and even to protect themselves.

The prey organisms often also use chemicals to obtain food without becoming food for others. This mode of communication is prevalent in all zones of ocean including the deep sea. Organisms that use visual and other modes of communication also rely on chemical signals. Chemicals are detected by receiver organisms either by olfaction at a distance from their source or by touch. The main advantage of chemical signals over visual ones is that vast areas of the ocean are actually under perpetual darkness and water is a hazy medium limiting visibility.

Sometimes food organisms undergo alteration in size and shape to avoid being eaten in response to chemical signals released by their predators. For example, Jeremy Long and his co-workers at the Georgia Institute of Technology proved that chemical signals from specific predators induce a shift in the shape of *Phaeocystis globosa*, a phytoplankton. When copepods are in the surrounding medium, *P. globosa* remains as single cells to avoid grazing, because copepods lose interest due to the small size of cells. On the other hand, when ciliates dominate in the medium to graze, the *P. globosa* cells form large colonies so that ciliates cannot engulf them.

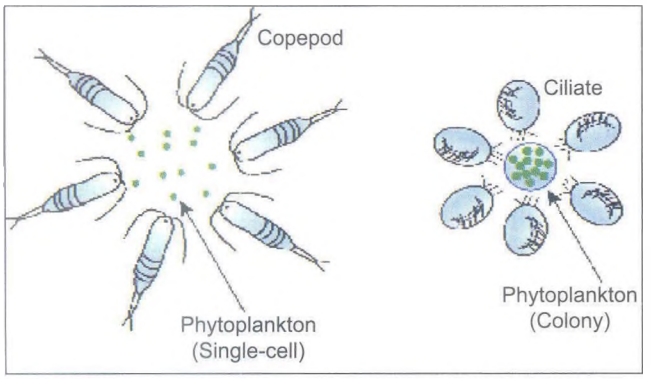


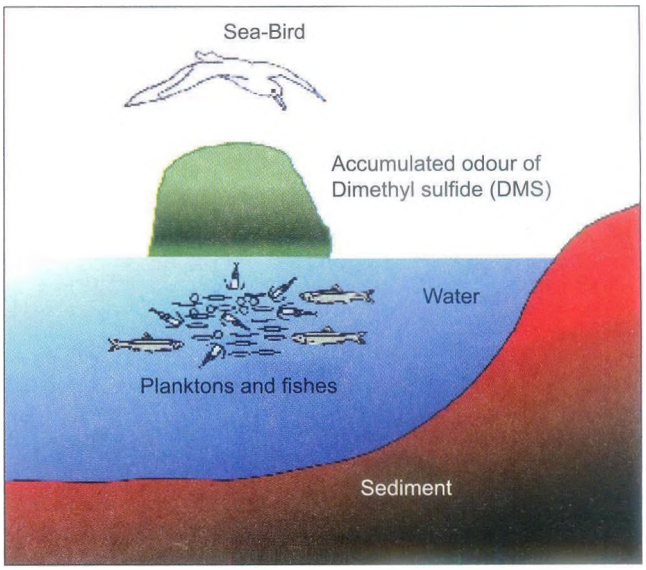
Image showing change in size and shape of phytoplankton in response to predator size

Now, how do sea birds detect fishing grounds in the sea? It is quite obvious that they cannot detect those productive areas from several thousands of kilometres? The answer is Dimethyl Sulphide (DMS), a gaseous compound released into the atmosphere when zooplankton feed on phytoplanktons in the water column. This was reported by sensory biologist Gabrielle Nevitt at the University of California in the 1990s.

According to him, the seabirds fly great distances, sometimes thousands of square kilometres to reach a productive area using DMS as a signpost and once there, they then can use both odour and vision to pinpoint and catch fishes directly. So, more DMS released from an area means more zooplankton feeding on phytoplankton indicating a potential fishing zone where sea birds such as storm-petrels, albatrosses, petrels, shearwaters and others can fill their stomach.

An investigation led by chemical ecologists Danielle Dixson and Mark Hay from Georgia Institute of Technology, USA, revealed that corals send out an emergency call in the form of a chemical signal in a matter of minutes when toxic seaweed *Chlorodesmis fastigiata* overgrow them in their vicinity. After detecting this emergency signal, the broad-barred goby fish (*Gobiodonhistrio*) reaches the site and eats the seaweed, accumulating the toxin which in turn protects the goby fish against predators.

Although marine organisms have the capability to detect the chemical signals from the water column, some chemicals are tightly associated with the body surface of the organisms and convey information in a surface-bound form to their own larvae when touched physically. For example,



Courtesy: Conceptualisation by Gabrielle Nevitt, University of California, USA

Photo source: Danielle Dixson, Georgia Institute of Technology, USA

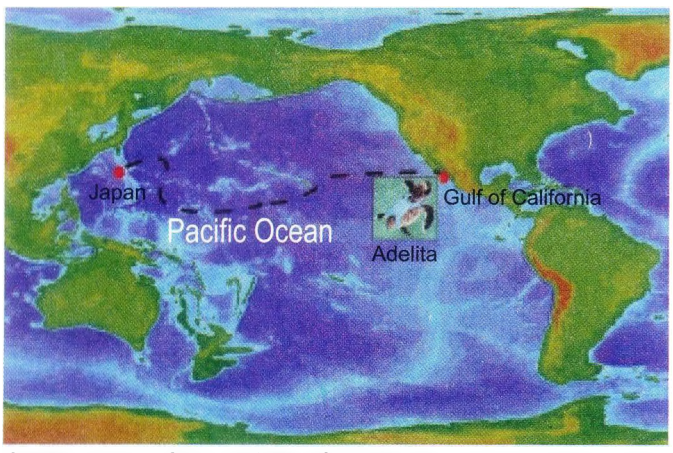
the Settlement-inducing Protein Complex (SIPC) associated with the barnacle shell promotes the gregariousness (living in groups) of barnacles. This protein complex was initially purified from the adults of barnacle *Balanus Amphitrite* by a team of Japanese biologists led by Nobuhiro Fusetani in 1998.

The SIPC is a glycoprotein which induces the settlement of the barnacle larvae near their own relatives. In 2013, a research team led by ecologist Hebert Ely Vasquez from Nagasaki University, Japan, also isolated a glycoprotein from the shell of pacific oyster *Crassostrea gigas* and proved a similar role in the gregariousness of oysters. Recognising these glycoproteins (molecular markers) is nature's gift to the larvae for finding a suitable home in a vast ocean.

Magnetic Signals

The Gahirmatha coast of Odisha is the largest nesting site in the world for Olive Ridley turtles. Lakhs of these animals arrive there for nesting purpose from the beginning of November every year. So how do these animals recognise their birthplace?

It has been reported that sea turtles can travel long distances with greater accuracy towards a specific destination. Turtle biologist Wallace J. Nichols in 1996 tracked the spectacular journey of Adelita, a young loggerhead sea turtle called *Carettacaretta* in the Pacific Ocean using a satellite tag. Adelita was rescued by the researchers from a fisherman after being caught in the Gulf of California and was reared in captivity. As she grew up, Wallace Nichols decided to initiate a research project by tracking this animal in the wild. So they decided to release her in the Gulf of California with a satellite tag fixed to her shell. Fortunately, the tag remained functional for almost one year and transmitted signals indicating Adelita's journey. To his surprise, Wallace noticed that the turtle crossed the entire Pacific Ocean at a speed of almost 100 km a week and reached a Japanese nesting beach.



Courtesy: Map- Srikanta Dora, CSIR-National Institute of Oceanography, Goa; Adelita Photo- Discover magazine (http:// blog.geogarage.com/2011/02/turtles-use-earths-magnetic-field-as.html)

A subsequent investigation by a team of researchers at the laboratory of Ken Lohmann in the University of North Carolina revealed that the turtles have an unusual capability to sense the magnetic field of the earth for navigational purposes.

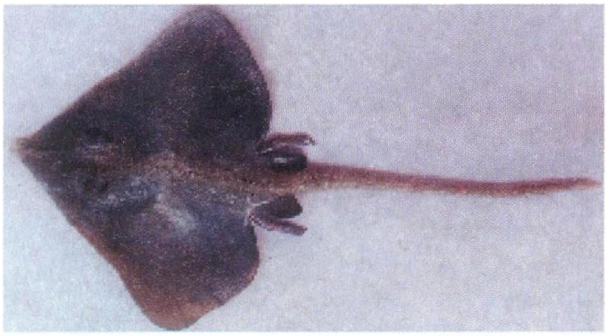
The magnetic feature of the earth does not fluctuate with season or weather making it a robust signal for migratory animals in the ocean. It is believed that turtles have tiny magnets called magnetites (iron-based minerals containing Fe_3O_4), which respond to the earth's magnetic field.

Besides turtles, magnetic signals also help in the navigation of sharks, lobsters and salmon. This signal basically provides dual information to the animals: the position and direction. The magnetic field acts as a Global Positioning System (GPS) and indicates the accurate position (latitude and longitude) in the ocean during navigation and the compass information helps the animals to orient themselves in a particular direction such as north or east.

Electrical Signals

Some marine vertebrates such as skates have the capability to communicate with each other during social and reproductive interactions using weak electric currents (usually less than one volt). The electricity is generated in the nerve cells or muscle cells of almost all animals for signal transduction; but in electric fishes, the electric field is produced outside the body by electric organs consisting of densely packed cells. The weak electrical signals can help in the recognition of own species and mates, information about attacks, or environmental conditions.

The signal emitted by one individual is detected by specialised sensory cells (electroreceptors) in the skin of a



A deep water skate from the waters of Andaman and Nicobar Islands, India
Courtesy: S. Venu and Ravi Ranjan, Pondicherry University, India

An electric ray from the coasts of Andaman and Nicobar Islands, India
Courtesy: Titus Immanuel, Madras Christian College, Chennai, India

receiving individual. Although this type of signal works well in the marine environment because seawater is a good conductor of electricity due to the presence of ions, it rapidly fades out in the medium if discontinued. Compared to the visual signal which depends upon sunlight and works during the daytime, electric signals can be effectively used during night time in the ocean for communication purposes.

In contrast to weak electric fishes, few species such as electric rays (torpedos) use strong electric currents (10 to 600 volts) to first paralyze their prey and ingest the meal thereafter.

Bioluminescent Signals

Bioluminescent signal is the light emitted by organisms. Compared to the terrestrial environment, organisms relying on the bioluminescent signals for communication purpose are more widespread in the ocean especially at depths where sunlight never penetrates. Around 76% of the main taxa living in the deep sea are bioluminescent animals such as comb jellies, tunicates, anglerfishes, hatchet fishes, dragon fishes, squids, jellyfishes, octopuses, and crustaceans.

The bioluminescent signals in the deep sea are used for finding food, attracting mates, and avoiding predators. The organisms also have functional eyes to detect bioluminescent signals. The light is produced by special cells present in the body called photocytes, or the luminescent chemicals are directly released into the seawater. The colour can vary from the dominant blue/green to the rare red/yellow/violet.

Blue light as a bioluminescent signal dominates in the ocean because of its far travelling capacity and is often found in organisms living in the water column, whereas green is the

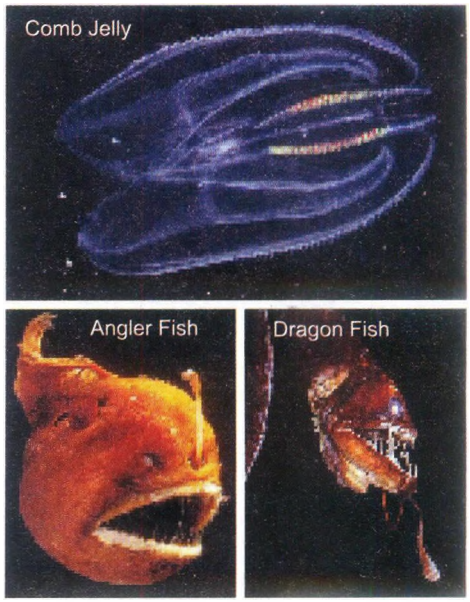


Image source: National Geographic. George Grall, USA(Comb jelly), Norbert Wu, USA(Angler fish) and Matt Davis, UK(Dragon fish)

second most common colour and is found in the sediment-dwelling organisms.

Although blue and green light are emitted by several bioluminescent organisms, deep-sea dragon fishes are an exception. They emit red light instead of blue, and their eyes are also sensitive to red light. So, they use red light as a unique strategy for communicating with each other in an environment where blue light is commonly used as a bioluminescent signal by others.

In the case of other organisms including lanternfishes and hatchet fishes, the distinct arrangement of light organs on the body may help in the recognition of their species and the opposite sex. An in-depth study of the light patterns emitted by these animals and the chemical complexities lying behind the bioluminescence will help us to understand the biological interactions in the deep sea and may also decode many more mysteries of the deep sea from where the first seed of life is believed to have germinated.

In spite of advancements in technology to retrieve samples from the deep sea and improvement in analytical skills, we are still far from a complete understanding of the basic languages that marine organisms speak. A better understanding of these languages will enable us in sustainable management of the ocean's biological resources.

But before we fully understand these languages, we have already started adulterating the ocean with different water-soluble compounds having odour released from cosmetics and personal care products as well as with man-made noise. Continuous introduction of these chemical compounds into the marine environment and production of noise might hamper the chemical and auditory mode of communication negatively leading to a devastating future for marine organisms.

Dr Gobardhan Sahoo, CSIR-National Institute of Oceanography (NIO), Biofouling and Bioinvasion Division, Dona Paula-403004, Goa. Email: gobardhanmarine.sahoo@gmail.com

REPORT

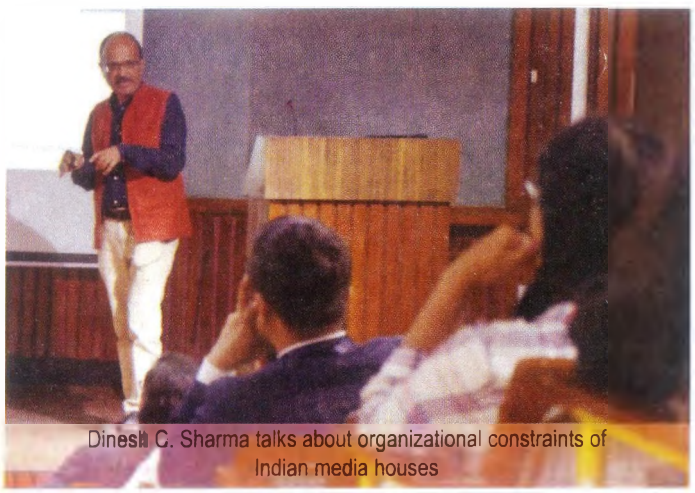
Science Communication Conclave 2020

Meher Wan

INDIAN Institute of Technology-Kharagpur organized the "Science Communication Conclave-2020" during 28-29 February 2020, in which science journalists, journalism students, science writers, and researchers from different research organisations came on the same platform to discuss how to bridge the gap between the media and research institutes for efficient science communication to the public.

IIT Kharagpur decided to celebrate February 28, celebrated in India as the National Science Day in commemoration of Prof. C. V. Raman's announcement of the discovery of the Raman Effect, by hosting a two-day conclave to bridge the gap between the media and the scientific world. In his address to the audience, Prof. Sriman Kumar Bhattacharya, Deputy Director, IIT-KGP, asserted, "National Science Day is a reminder of the importance of science dissemination and it should be done by any means possible."

The conclave comprised three panel discussions and several lectures on different issues related to science communication and journalism. The journalists raised their concerns and academic researchers discussed their issues to understand each other better. Some issues discussed in the conclave were: How do scientists' reservations about not opening up to the media jeopardize the science & technology news? Are strict deadlines and pressures of time responsible for misrepresentations in science and technology news? Is science meant for breaking news? Is scientific jargon a barrier in the way of effective science journalism? How to make science more popular in different media platforms?


Dinesh C. Sharma talks about organizational constraints of Indian media houses

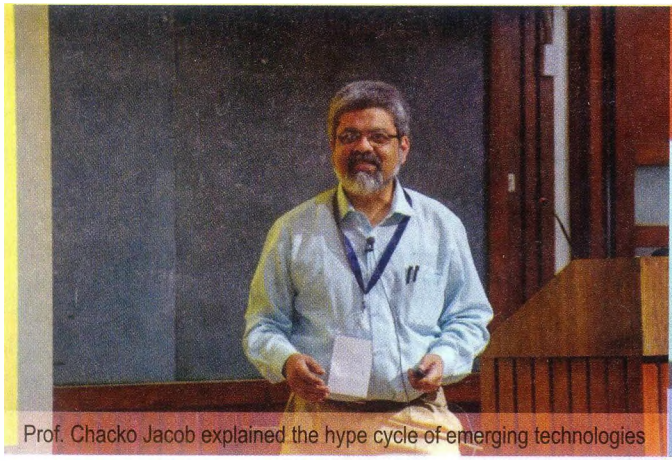
Prof. Baidurya Bhattacharya, Dean, International Relations, IIT KGP and convenor of the conclave delivered the opening lecture and highlighted the follies and lack of rigour demonstrated by journalists in the widely known case of cloning technology. He said, "There is an enormous need to disseminate factually correct information and at the same time to live up to the demands of the media industry."

Journalist and former Managing Editor, *India Science Wire* talked about the organizational constraints of media houses, dependence on advertisements, and asserted that more science and technology news must get place in the mainstream media.

Senior science journalist Ms T.V. Padma delivered her lecture on "Evolution and Futuristic Trends in Indian Science Journalism". She explained the current status of science journalism in India and tried to predict the future trends with the help of available data in the field of science communication.

Veteran journalist Mr Pathik Guha discussed the methodology for science communication through vernacular story-telling. He suggested budding science communicators to read and learn from well known international cases of reporting for great discoveries. Shashank Shekhar Dubey, Deputy News Editor, *Times of India* highlighted the challenges of science stories in Indian print media. Dr Ipsa Jain, Graphic Artiste & Science Communicator talked about visual science communication and graphics. Ms Sahana Ghosh, Science Journalist, *Mongabay India* delivered a lecture on "Solutions & Data Journalism for Science Reporting, Multimedia and Social Media Outreach". She exhibited how their group is communicating science to the deprived and indigenous communities of India and helping them in solving their technical problems by their own efforts.

From the researchers' side, different case studies pertaining to science journalism were presented and new scientific studies of direct concern to the society were also showcased. Prof. Parthasarathi Chakraborty discussed the recent advancements in environmental geochemistry



Prof. Chacko Jacob explained the hype cycle of emerging technologies

Prof. Sangeeta Bhattacharya talking on how to cover public health effectively in light of COVID-19

and ocean pollution. He explained the effects of mercury contamination on human health, specifically the outbreak of the famous Minamata disease in Japan due to Methyl mercury compound and similar potential cases in India.

Prof. Sudeshna Sarkar discussed how artificial intelligence is changing the world. Prof. Swagata Dasgupta delivered a talk on "The Art of Science Storytelling – Case Study of Enzymes" while Prof. Bhargab Maitra highlighted the engineering aspects of "Urban Safety Planning and Transportation" to reduce road accidents and improve living.

Prof. Abhijit Mukharjee discussed his recent findings about "Water Resources: River Linking, Water Security, Virtual Water Flows, Water Governance". He emphasized on the preparation of a groundwater policy to save groundwater on time. He said that urgent government intervention in addition to public awareness is needed to save the groundwater in India.

Prof. Brajesh Dubey asserted the need for smart waste management and presented new methods to do so in his popular lecture. He mentioned that proper waste management can't be done without public awareness and science journalists/communicators can play a very important in spreading awareness.

Prof. Sangeeta Bhattacharya talked on "Covering Public Health", taking the case of COVID-19, and explained how the news about public health should be covered by science writers and journalists. Prof. Dilip Swain talked about innovative ways to increase the production of crops using much less water. He also talked about food security and innovative ways of crop production management to maximize food production using minimum resources.

Prof. Chacko Jacob highlighted the hype cycle for emerging technologies by taking nanotechnology as an example. He suggested that communicators must be sensitive to the hope, hype and reality cycle of new technologies to avoid projected over-hyped expectations of the newborn technologies.

The burning questions of media-scientists relationship were discussed in panel discussions which comprised several renowned media persons and scientists. The topics of the panel discussions were: "Lab to Media — Bridging the Language Gap", "Is Science meant for Breaking News?", and "Role of Alternative Media in Taking Science to Wider Audience".

Prof. Pallab Dasgupta asserted the complimentary roles of scientists and journalists in making our society better. He said, "Remember, we are not adversaries. We need each other to take the news related to science to the people." Prof. Sunando Dasgupta pointed out, "Science is a process of inquiry. You cannot expect breaking news to happen on a daily basis..."

The writer of this report was also a part of a panel discussion and highlighted the role of CSIR-NISCAIR in the dissemination of science and technology to the public including bridging the gap between media and scientists. Prof. Satdal Saha, Prof. Jenia Mukharjee, Satarupa Sen Bhattacharya, Lipsa Panda and others also joined the discussion. Panel discussions were moderated by Prof. Anandroop Bhattacharya, Prof. Baidurya Bhattacharya and Chirosree Basu.

The conclave also showcased the art works of Ipsa Jain and Lipsa Panda who are using art and aesthetics to communicate science.

Celebrated professor and Dean of Sponsored and Industrial Research Cell, IIT KGP Prof. Suman Chakraborty highlighted the need for training science communicators and scientists to disseminate the scientific news in a factually correct way. He asserted that such training should be a part of the advanced research trainings." In the concluding lecture, Prof. P.P. Chakraborty, former director of IIT KGP, proposed to take science to school children through innovative storytelling.

The two-day conclave was attended by a wide number of research scholars, students, journalists, science communicators, science writers and professors.

Dr Meher Wan is a scientist at CSIR-NISCAIR and assistant editor in *Science Reporter*.

18th Science Fiction Conference

Srinarahari

Dr Pramod Yeole, Vice-Chancellor of Dr Babasaheb Ambedkar Marathwada University inaugurating the conference

THE Indian Association for Science Fiction Studies®, Bangalore (IASFS), Indian Science Fiction Writers Association, Ayodhya (ISFWA), Marathi Vidnyan Parishad, Mumbai (MVP), Marathwada Shikshan Prasarak Mandal, Aurangabad (MSP) and Deogiri Institute of Engineering and Management (DIEM) joined with the host Mukthananda College, Gangapur, Aurangabad District, in organizing the 18th Science Fiction Conference at Aurangabad, Maharashtra during 10-11 January 2020.

While Dr Madhusudan N. Sarnaik and Dr Balaji A. Navale welcomed the gathering, Dr.Srinarahari, Secretary-General, IASFS displayed how the growth of science fiction (SF) has taken place after the second wave of Indian SF from the sixties of the twentieth century. He briefed about the conference theme, "Science and Science Fiction: Interdisciplinary and Multidisciplinary Perspective" and also highlighted how the genre has influenced other branches of knowledge in their futuristic vision.

Dr Pramod Yeole, Vice-Chancellor of Dr Babasaheb Ambedkar Marathwada University, Aurangabad inaugurated the Conference by lighting a lamp. Speaking on the occasion the VC pointed out the positive impact of Science and Technology in the life of the common man in the street. Being a Professor of Pharmaceutical Sciences for thirty-two years, he cited a number of instances to explain how the theme was relevant in the current context to churn out solutions for many complex issues. He called for the translation of global works to the vernacular and regional languages to enable the local people to know the current trends in this direction.

Dr Arvind Mishra, Secretary, ISFWA spoke about the association and its activities explaining how the association could provide a platform for the Hindi writers to publish their works regularly in *Vignyan Katha* magazine.

Mr Mohanrao Savant, Member of the Executive Council, and Mr Deshmukh College Development Committee of MSP joined the dignitaries while releasing the peer-reviewed – online and print version of *International Science Journal* during the inaugural session.

In his keynote address Mr A.P. Deshpande, honorary Secretary of MVP traced the development of the genre from the times of the *Vedas*, the *Ramayana* and the *Mahabharata*. He traced the contributions of the British, and the boom in the growth of the genre in the American continent. He also pointed out how the MVP could conduct the short story writing competitions during the seventies and how the writers in Marathi could align themselves to the emerging trends of popularizing science and science

fiction along with stalwarts like Jayant Narlikar, Bal Phondke and others.

He gave an account of the growth of the genre in other vernacular languages like Hindi, Bengali, Kannada, Malayalam, and Tamil. He mentioned *It Happened Tomorrow* (1993) edited by Bal Phondke and the selection of Laxman Londhe's "Einstein the Second" as the best Indian Science Fiction story from the sub-continent as proof of a global flavor in Indian SF works. The impact could be seen in the present day with 120 Marathi Science Fiction Writers publishing SF stories in 400 magazines every year.

Professor of astronomy at the University of Wyoming, USA, Michael Brotherton, who is a Science Fiction writer and editor of anthologies, gave a video talk on the "Synergies of Science and Science Fiction". He remarked that Science and SF are complementary to each other. Quoting Carl Sagan he conveyed that science is a way of thinking rather than a body of knowledge. He also quoted Albert Einstein who said that imagination is more important than knowledge. Citing the idea of flying cars, he demonstrated how telescope, spacecraft, and the time machine are interconnected. He said that science requires speculation as much as skepticism.

In a plenary session, Dr Ashok Thorat, Director, Center for Digital Humanities, Pune, explained the concept and scope of SF and highlighted how it can encompass humanities, science and other branches of knowledge. He brought out the point how Science Fiction and Digital Humanism go hand in hand in their methodology.

Dr Arvind Mishra speaking on Indian SF scenario highlighted how the social media has provided a platform to unite every writer in the genre and interact over a particular topic in recent days.

Mr Harish Yadav presented a paper on "Magic and Mentalism in Science Fiction" where he dealt with the definition of SF, magic, mentalism, and magic in SF in print and movies.

Speaking on the occasion of the birth centenary celebration of Isaac Asimov, Dr Srinarahari drew out a few anecdotes from the life of Asimov and focused on his Science Fiction works. He spoke about the foundation series and robot novels and their culmination in the novel *Robots and Empire* (1995). In fact, the Oxford English Dictionary acknowledges Asimov for his coinage of the terms: the Three Laws of Robotics; Positronic Brain; and Psychohistory.

Mr Harish Yadav during his mentalism show

Dr Arvind Mishra addressing the gathering

Concluding his talk he explained that the Indian Association for Science Fiction Studies®, Bangalore, was established on the birthday of Isaac Asimov on 2 January 1998. Now, the institution is celebrating its 22nd year of establishment. Asimovian topics were chosen by many scholars in presenting their papers during the last 18 Science Fiction Conferences held in India. This is a tribute to the great giant of Science Fiction.

Apart from the presentation of one hundred and thirty papers by the participants, there was a magic show entitled "SF & Mentalism" by Harish Yadav.

The 19th Science Fiction Conference will be organized by the Bangalore University in collaboration with IASFS, ISFWA and others during 5-7 October 2020 at Bangalore.

Report and photos by Dr Srinarahari, Secretary-General, Indian Association for Science Fiction Studies, # A 107, DS MAX Signature, LKR Nagar, Devinagar, Near Aadhar Office, Bangalore-560094, Karnataka. Email: drsrinarahari@gmail.com; doctorhari567@gmail.com

The Man from the Nine Dimensions

A 3D Full dome movie on the Theory of Everything

Vasumathy Jambunathan

WHEN I saw the notice announcing the screening of this movie at the Bangalore Jawaharlal Nehru Planetarium, my interest immediately got piqued. Nine dimensions?? It's hard enough for a common man to even imagine beyond the usual three dimensions and the 4th dimension of time; forget about nine!!

This special dome movie was hosted at the planetarium as part of an outreach programme by ICTS - International Center for Theoretical Sciences, Bangalore. Before the movie commenced a short lecture explaining the scientific concepts in the movie was given by Professor Hirosi Ooguri (Fred Kavli Professor of Theoretical Physics and Mathematics). The movie has received numerous prizes and honours including the 2016 Best Educational Production Award of the International Planetarium Society.

This planetarium dome movie depicts the elusive search of scientists over the years for the "Theory of Everything". Nicknamed TOE, the elusive theory is depicted as a mysterious man who keeps running away from the scientists who are chasing him. TOE would unify the two great bastions of twentieth century physics - the general theory of relativity and quantum theory.

General relativity describes the large scale cosmological structure of the universe. Quantum theory describes the microscopic subatomic structures. The unification of these theories would explain both the very big and the very small. Great scientists such as Albert Einstein and Stephen Hawking have spent days in pursuit of this elusive theory.

There are four fundamental physical forces in our universe: Gravity, Electromagnetic force, Weak nuclear force (force between electrons and nucleus in an atom) and Strong nuclear force (force between protons and neutrons in an atom).

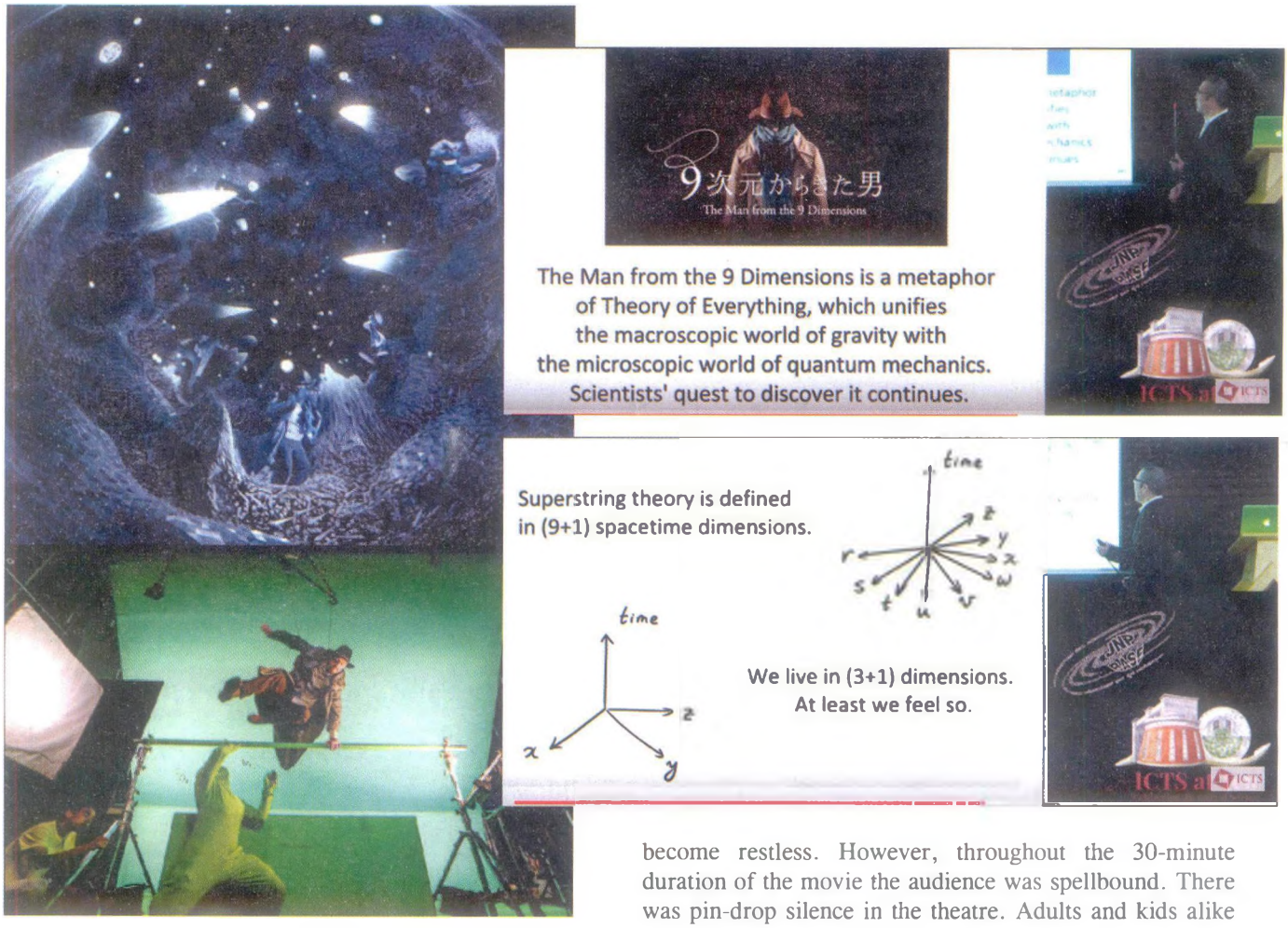
Today a theory known as QFT - Quantum Field Theory - unifies the three non-gravitational forces. But General Relativity theory based on gravity and QFT are mutually incompatible theories - they cannot both be right. These two theories usually apply to different domains - QFT to small mass sub-atomic particles and GR to the large scale high-mass stars and galaxies. However, in regions of extremely small-scale and high-mass, such as a black hole or during the beginning stages of the universe, this incompatibility between GR and QFT is apparent.

To resolve this conflict, a theory unifying gravity with the other three forces must be discovered: a single theory that is capable of describing all phenomena. Today, the superstring theory is the leading candidate for the Theory of Everything.

According to the superstring theory, the elementary particles in particle physics are strings of energy stretched out in one dimension. The Standard Model of Elementary Particles has 17 types of elementary particles. The superstring theory describes everything in terms of a single type of string. The differences in the vibration patterns of the string are believed to correspond to the various types of elementary particles.

To mathematically model the strings, the three spatial dimensions that we are familiar with are not sufficient; instead, nine spatial dimensions are necessary. The

Image Courtesy: Wikipedia
https://en.wikipedia.org/wiki/Calabi%E2%80%93Yau_manifold



remaining six dimensions constitute the "Calabi-Yau space". The Calabi-Yau Space is folded very compactly, and can neither be seen or felt by us. This is why we only observe our three-dimensional world.

In the superstring theory, the string vibrates according to the shape of the Calabi-Yau Space, and the differences in the vibration patterns are thought to correspond to the 17 types of elementary particles.

In the movie, the mystery man TOE escapes with ease from the scientists and invites us to a fantastic journey through all the nine-dimensions. He traverses space and time, jumps between the microscopic world to the macroscopic world. TOE helps us to wander from the present day to the distant past until the birth of the Universe. He takes us on a journey beyond dimensions. Through a lot of elaborate graphics, the movie gives a visual representation of the six extra dimensions of the Calabi-Yau space as it is seen from our three dimensions. The film also depicts the Standard Model of particle physics with visual representations of elementary particles such as Higgs Boson and Neutrino.

One would have thought that with a subject so scientifically complex, the non-scientific community in the audience would have been bored or the children would become restless. However, throughout the 30-minute duration of the movie the audience was spellbound. There was pin-drop silence in the theatre. Adults and kids alike were riveted and glued to the screen.

A subject that is normally best described using differential and integral equations came alive for all of us on screen ala Bollywood style. TOE kept the audience enthralled with his singing and dancing. Jumping around between microscopic and macroscopic worlds he leads all the scientists through a terrific chase!

In the last scene, the scientists manage to almost catch TOE, but are left with only a string from his shawl while he runs away again leaving us with the conclusion that while the String theory is a good candidate for TOE, there is still a long way to go to really understand the Theory of Everything.

Ms Vasumathy Jambunathan is an engineer from BITS Pilani and holds a Masters degree in Chemistry. Currently she is a senior technical software architect at Infosys in Bangalore. Address: 5032 Sobha Palladian, Yemalur road, Marathahalli, Bangalore-500037. Email: suma78@yahoo.com

Pictures and technical information on Theory of Everything, Calbi Yau space ad Superstrings theories have been referred from the following websites:

https://en.wikipedia.org/wiki/Theory_of_everything
https://www.icts.res.in/lectures/9-dimensions
https://www.miraikan.jst.go.jp/sp/9dimensions/en/commentary/
https://ooguri.caltech.edu/documents/80-aspen_times_article.pdf

Science Reporter's

Science Fiction & Science Cartoon Competition 2019

Results!

Here are the Results of the Science Fiction Competition!

Best Entry	:	*Perspective* by Gariyashi Deka
Second Best Entry	:	*Purpose* by Sucheta S. Mummigatti
Third Best Entry	:	*The Network* by Amogh Kannan
Fourth Best Entry	:	*For the People by the People* by Ishanavi Dhiman
Fifth Best Entry	:	Gaia — *The Story of Survival of Human Species* by Siddhant Gokhle
Sixth Best Entry	:	*I, AI* by Beas Chattaraj

And here are the Results of the Science Cartoon Competition!

Best Entry	:	*The Blind Spot of Pollution* by Satyawan B. Aher
Second Best Entry	:	*Cultured* by Mansi Mandal
Third Best Entry	:	*Plastic Pollution* by Shweta Hirani

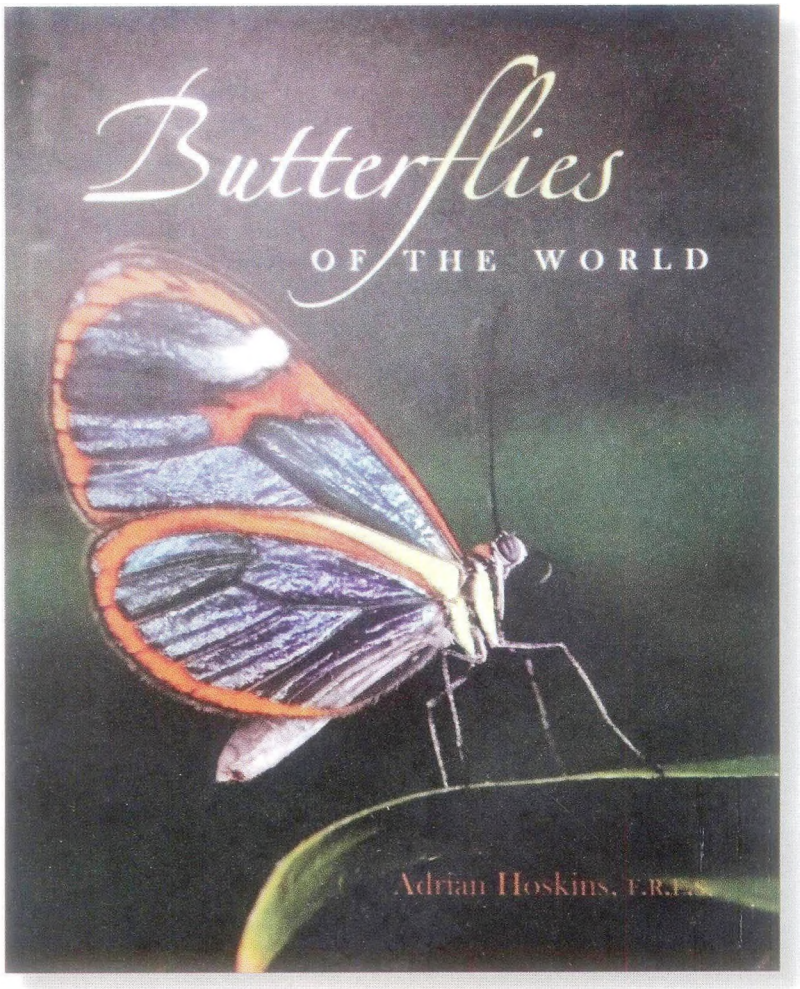
Congratulations
ALL THE WINNERS!!!

Besides, Science Cartoon entries by the following have been found worth publishing:

1. *Snell's Law of Refraction* by Satyawan B. Aher
2. *Comparing Heart Health* by Shweta Hirani
3. *The Nuclear Debate* by Mansi Mandal
4. *My Far-Sighted Grandpa* by Mansi Mandal
5. *The Chemistry Inside DIY!* By Meera Nair
6. *The Year 2080* by Meera Nair

However, as a mark of encouragement some good Science Cartoon attempts by the following will also be published:

1. *Mobile Apps* by Shweta Hirani
2. *Doraemon and Shizuka* by Sai Gogate and Kashi Jangid
3. *Nobita* by Anshuka Saha
4. *See Children this is the Real Science* by Aaryan Padhiyar
5. *Alexandrite* by Kishan Chaurasia
6. *Cinderella* by Zara Warsi



Title of book: *Butterflies of the World*
Author: Adrian Hoskins, F.R.E.S.
Publication Date: October 2018
Total Pages: 312 pages
ISBN 9781421427171
Price: $34.95
Publisher: Johns Hopkins University Press

Reviewed by
S. Suresh Ramanan

LIKE most people, I too had an obsession for the prettiest and modest Insects – the Butterflies. It is believed that butterflies and moths account for 9% of all life forms on earth. This diversity is really a feast for the human eyes. Poets describe that a fluttering of a butterfly can make an observers' heart wiggle. The elegance, suave and opulence of this tiny creature has fascinated biologists and it developed into a separate scientific study – Lepidopterology. The knowledge or information gathered by the researchers till date is beyond one man's or book's comprehension ability. However, the beginners need a stepping stone and this book *Butterflies of the World* written by Adrian Hoskins can be the best book to begin. The author's vast experience and his mastery over the subject are reflected in his writing style.

Before devouring the content of this book, as a reviewer, I would like to highlight some points. There are numerous pamphlets, identification guides and books about butterflies (Braby, 2016; Carter, 2002; Kunte, 2000; Morgan, 2013; Sandved and Cassie, 2004; Schappert, 2005; Todd, 2013). However, these mostly tend to overemphasise on a particular region or focus more on the field identification with colourful photographs leaving the readers with few descriptive details or bombard the readers with too much information.

This book strikes a balance between pictures as well as descriptions. This makes it more appropriate for beginners. Generally, a book written about flora and fauna tends to be monotonous making the readers skimp or skip pages. I assure the readers that it will not happen with this book. This doesn't mean that there are no drawbacks or limitations. Any lepidopterist can point out some information lacunae about certain species. However, with only 312 pages to describe world butterflies, the author has done his job well.

This book is divided into five sections with a short introductory chapter. I would like to vouch for the interesting story about Alfred Russel Wallace in the dedication page to the readers. In the one-page introduction, the author not only explains the content of the book but also emphasises on the importance of NGOs in conservation.

The first section, *Origin and Evolution* is very precise and gives the crux of the butterfly's origin and evolution. The second section is the heart of the book – *Butterfly Biology*. I would say that it should be titled as Butterfly biology and ecology, as the author describes the anatomical part as well as the natural enemies and the survival strategies of the butterflies. Apart from the usual life cycle description, there is significant information about androconia, hearing organs, cannibalistic feeding behaviour, myrmecophagy, aphytophagy and pseudoscorpion hitchhikers. Some species of butterfly larvae do feed on ants (myrmecophagy) or aphids (aphytophagy) which may appear unusual for the beginners. The interesting part is the mechanism or strategy adopted by the larvae. The Moth Butterfly (*Liphyrabrassolis*) larva allows itself to be captured by the weaver ants (*Oecophyllasmaragdina*). The weaver ants usually gulp down any captured larvae but that will not happen with the Moth Butterfly larvae. It is the reverse condition where the larvae gulp down the ant grubs inside the nest. Furthermore, the larvae pupate inside the ants' nest and emerge an adult. The book holds such attention-grabbing examples.

There are some witty statements in the book which might amuse certain readers. For instance, while explaining the balance of nature and prey-predator relationship, the author states "*The weapon of this warfare is evolution*" (p. 65). The wing of the butterflies performs a lot more function than flying. In certain species, the wing is modified to provide camouflage, as a survival strategy. The remaining part of the second section revolves around this topic.

The third section – *Butterfly Families* – is the main theme of the book. The seven butterfly families are explained meticulously and coherently. In the beginning, the author provides an overview and thereafter the relevant pictures at the right context make the book admirable. As a reviewer, I can't explain the beauty of each butterfly here. However, I would like to point the readers to Cramer's 89 butterfly (p. 143), Blue Glasswing (p. 161) and the world's largest butterfly, Queen Alexandra Birdwing (p. 275) which I adored.

The next section is about *Habitats and Conservation* and most of the readers need no explanation further. The world is facing dire stress due to human actions and there are a lot of big steps and policy decisions to be taken by the governments but there are small steps that we, as individuals can take. The author says, "I *most strongly urge every reader of this book to become actively involved in conservation* (p. 295)". He suggests that it can begin with a small step such as signing some online petition too.

Finally, a clear-cut and precise glossary makes the fifth section of the book. The index provided at the end cannot be that useful as it covers only the scientific names of butterflies. There is a need for well-structured index covering the entire content of the book. There are no references enlisted in the book but I would encourage the readers to visit the website (https://www.learnaboutbutterflies.com) hosted by the author himself for more information and current updates. There is another book by the author, *1000 Butterflies: An Illustrated Guide to the World's Most Beautiful Butterflies,* which is more complementary to the reviewed book.

I would recommend this book as an excellent reference for the beginners and students in entomology and lepidopterology.

S. Suresh Ramanan, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu, Jammu and Kashmir. Email: sureshramanan01@gmail.com

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PRIZE PUZZLE

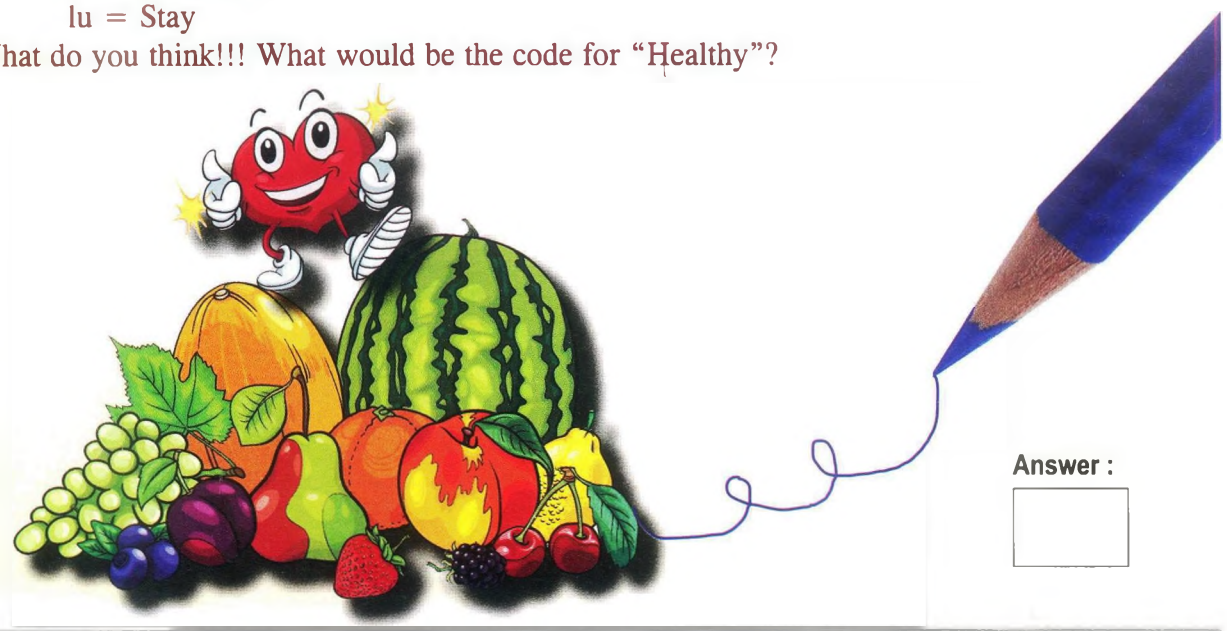
Rama and Jaya are playing a game. Rama told Jaya to consider the following statements and gave her few hints to find the code for the word "Healthy".

Statement 1: Draw With Blue Pencil.

Statement 2: Eat Nutritious Stay Healthy.

If ra = Eat
it = Nutritious
lu = Stay

What do you think!!! What would be the code for "Healthy"?



Answer :

There are three prizes of Rs 500/- each for three correct entries. In case of a large number of correct entries, the prize winners will be selected through a draw of lots. The decision of the Editor, *Science Reporter* will be final.

Name : .....

Address : .....

.....

..... Pin code : | | | | | |

Age : ..... Email : .....

Sex : ..... Contact no. : .....

Occupation: ☐ Student ☐ Housewife ☐ Teacher ☐ Professional ☐ Retired ☐ Other

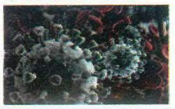
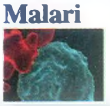
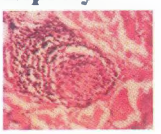
Educational level: ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate

Send your entries to:
Puzzle Corner
Editor, *Science Reporter*
CSIR-NISCAIR
Dr KS Krishnan Marg,
Pusa Campus
New Delhi-110012

Last date for the entries to reach us: 01-05-2020

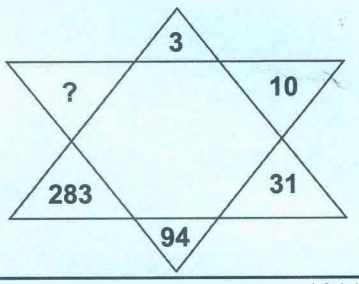
- *Please fill up the questionnaire at the back.*
- *You can send your answers on a photocopy of this page as well.*
- *Prize puzzle winners will be paid through bank transfer for which bank account details will be requested.*

MATCH THE FOLLOWING DISEASES WITH THEIR SYMPTOMS

S.No.	Disease	Symptoms
1.	**Cirrhosis** 	a) The disease typically affects the respiratory tract of mammals, including humans. They are associated with the common cold, pneumonia, and can also affect the gut.
2.	**Anaemia** 	b) It is a disease that causes the loss of skin colour in blotches. It can affect the skin on any part of your body. It may also affect the hair and the inside of the mouth.
3.	**Coronavirus** 	c) In this disease, the liver is unable to purify the blood, break down toxins, produce clotting proteins, and help with the absorption of fats and fat-soluble vitamins.
4.	**Malari** 	d) The first symptom of this disease is usually a painless lump.
5.	**Vitiligo** 	e) It describes the condition in which the number of red blood cells in the blood is low. People with iron deficiency may experience this disease.
6.	**Malignant tumor** 	f) It is a bacterial infection that grows very slowly and can have severe health consequences. It attacks the nervous system, causing significant disfigurement.
7.	**Leprosy** 	g) It is a life-threatening disease. It's typically transmitted through the bite of an infected Anopheles mosquito. it can also be transmitted through an organ transplant and a transfusion.
8.	**Lyme Disease** 	h) Severe headaches, Additional EM skin rashes, Facial paralysis (i.e. Bell's palsy Intermittent muscle, joint, tendon and bone aches are some of the most common symptoms of this disease.

Which Number?

Which number comes in the place of the question mark?



Contributed by ASR Murthy, Assistant Engineer, T.V Tower, Malakpet, Hyderabad-500036.
Email: asrmurthy5@gmail.com

Solutions to puzzles published in February 2020 issue

PRIZE PUZZLE Answer: Polar Bears

Polar Bear's fur is colourless as each strand is pigment-free and transparent with hollow-core reflecting light and giving an impression of being white in colour in certain lights.

Number Puzzle Solution

Answer: 396

The sequence is (a+b+c)(abc)

Therefore First row (1+2+3) (1*2*3)=36

Second row= (2+4+1)(2*4*1)=56

Third row=(4+3+2)(4*3*2)=216 ,

Thus fourth row= (3+2+6)(3*2*6) = 396

Metallic Puzzle Solution

The prize winners on the basis of draw of lots from among the correct entries are:

- **Abhishek Jain**
  34/45, II Floor, West Patel Nagar, New Delhi-110008
- **Prathamesh S. Sinha**
  Type-4 I Floor, Q No. 82, Sec-3 Sadiq Nagar, Near Sama Hospital, New Delhi-110049
- **Soumyajeet Pal**
  Qtr No. 21/05/02, Sec-21, IOCL, Haldia, Purbia, Midnapore, West Bengal-721607

Congratulations all the winners!

AppStreamer — A New Software to Stream Data

A team led by Indian-origin researcher Saurabh Bagchi who is a professor at Purdue University, US, has developed an AppStreamer which is a software capable of streaming the data and reducing the space occupied by apps on a smartphone. Without deleting the already existing apps, the software enables the users to continue downloading the apps they desire. The software helps in streaming the data to an app from a cloud server when required which means the app will occupy only the space it needs on a mobile at any given time. 5G connectivity can better be accommodated by using AppStreamer.

Source: https://www.purdue.edu

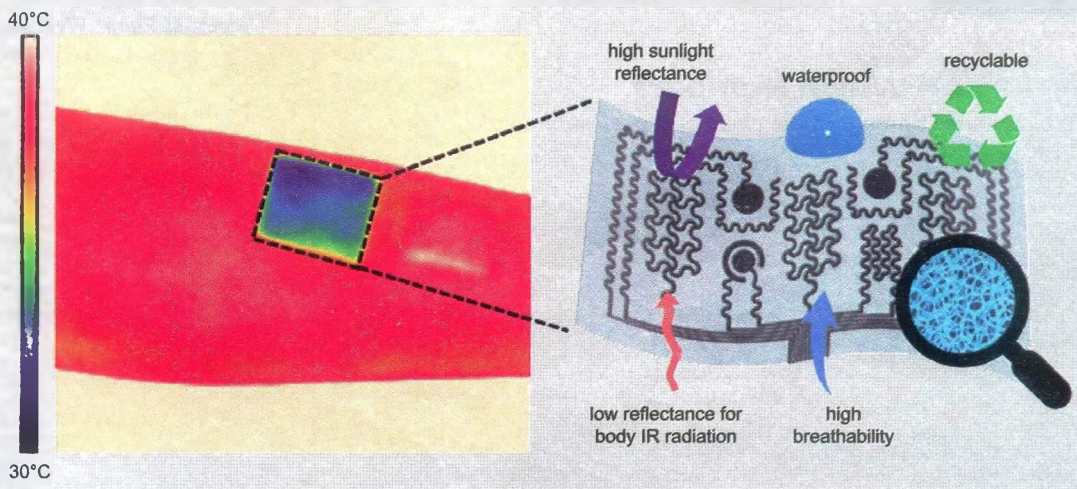
Image Credit: Jamayal Tanweer

Wearable AC — On-skin Electronic Device

ENGINEERS from the University of Missouri have developed an on-skin device called "Wearable air conditioning" having the ability to monitor blood pressure, the electrical activity of the heart and the level of skin hydration.

The device is breathable and waterproof and delivers personal air conditioning to a human body by the process of passive cooling. The cooling does not utilise electricity, such as a fan or pump avoiding any discomfort to the user. Presently, the device is a small wired patch, and researchers suggest that after two years they'll be able to design a wireless version. The findings of the work were published in the Journal *Proceedings of the National Academy of Sciences.*

Source: https://news.missouri.edu/2020/wearable-ac/

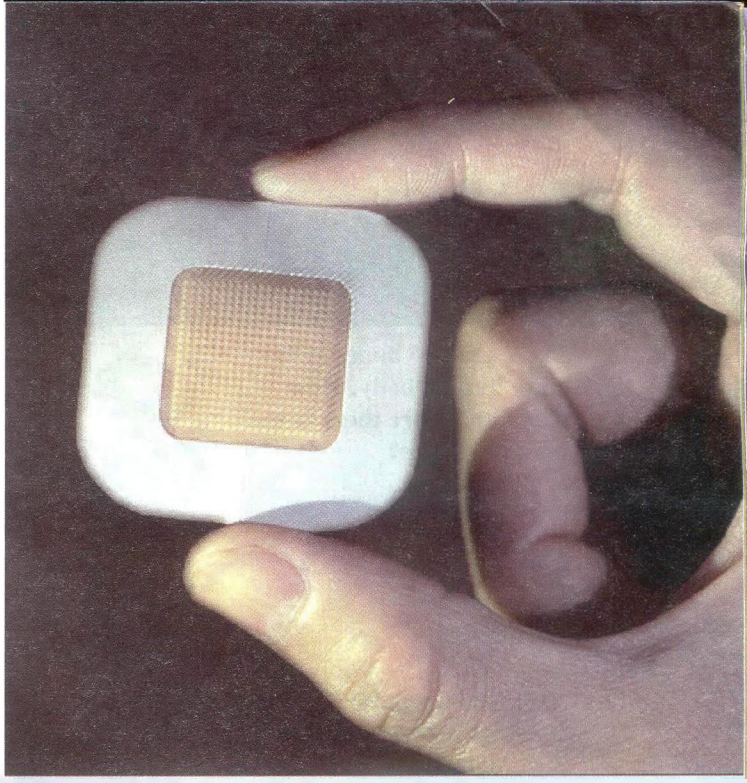


Smart Insulin-delivery Patch

RESEARCHERS from the University of California Los Angeles, University of North Carolina, and MIT have designed a smart insulin-delivery wearable patch which could automatically regulate and monitor glucose level in diabetics by delivering the required insulin dose.

The stick-on device is about the size of a U.S. quarter coin and has tiny needles preloaded with insulin, which are less than a millimetre in length and made out of a polymer that's sensitive to glucose. The technology is cheap to manufacture and one day people with diabetes will hopefully be able to put on one of these patches in the morning without worrying about the glucose levels throughout the day.

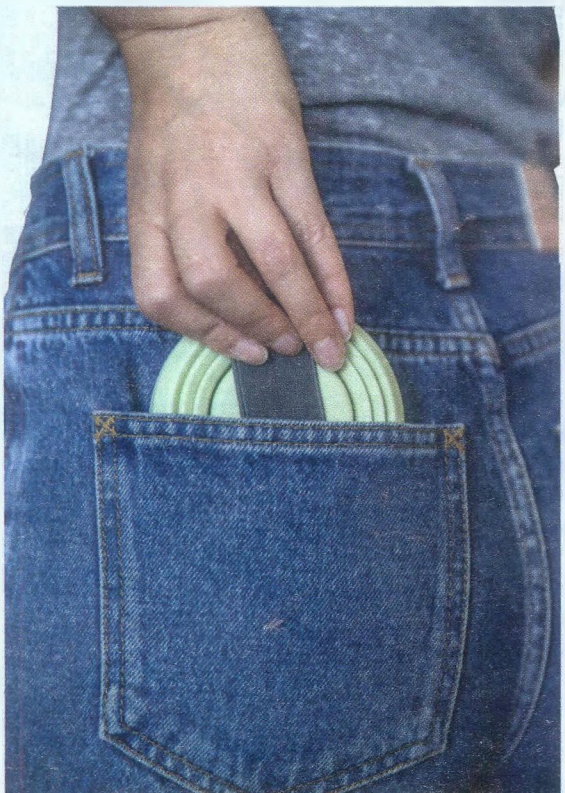
Source: http://news.unchealthcare.org/



HUNU — A Reusable Coffee Cup

HUNU is a beautifully designed and easy-to-carry reusable coffee cup which is incredibly light weighing less than 100 g and measures less than 0.75 inches thin when folded down. Because of collapsible design HUNU can easily be fitted in the pocket. All materials used in designing are BPA-free and fully non-toxic.

Source: https://www.kickstarter.com/

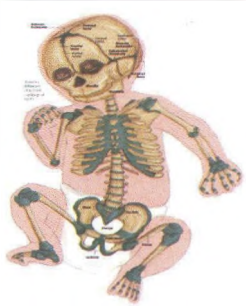


1. Folds down to less than 2cm/0.75 inch to fit in any pocket or bag
2. Plug for drinking hole means no leaks in your pocket
3. Big enough to fit any Barista standard sized coffee
4. Removable insulating band for those extra hot drinks
   - Dishwasher safe and incredibly easy to clean
   - BPA free and fully Non-Toxic bamboo and silicone
   - Ultra portable and infinitely reusable

All about Bones

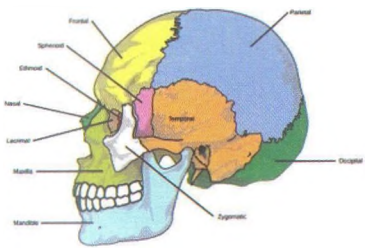
Babita Saha & Neel Datta

1. **There are 206 bones in the adult human body. How many bones are there in the infant skeleton?**
   a. 100-150
   b. 150-200
   c. 200-250
   d. 300-350



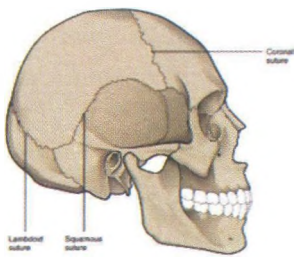
2. **Name the temporary openings present between the cranial bones at birth.**
   a. Cranial openings
   b. Frontal sinuses
   c. Fontanelles
   d. Epiphyseal plates

3. **Which bone protects the brain?**
   a. Calcium
   b. The cranium
   c. The cerebrum
   d. The cerebellum

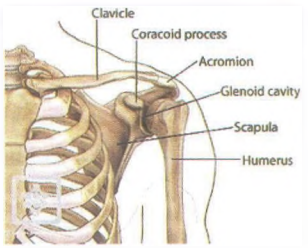


4. **Which is the only movable bone in the skull of humans?**
   a. Ethmoid bone
   b. Mandible bone
   c. Nasal bone
   d. Lacrimal bone

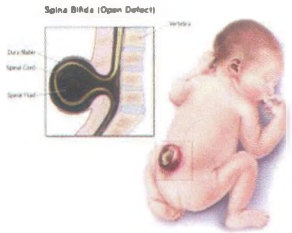
5. **The joint present between the human skull bones is**
   a. Hinge joint
   b. Immovable joint
   c. Fibrous joint
   d. Synovial joint



6. **Which of the following is not part of an axial skeleton?**
   a. Sternum
   b. Mandible
   c. Humerus
   d. Sacrum

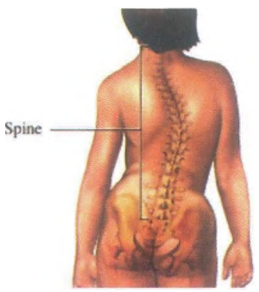


7. **What does an incomplete closure of the vertebral column cause?**
   a. Scoliosis
   b. Spina Bifida
   c. Lordosis
   d. Kyphosis

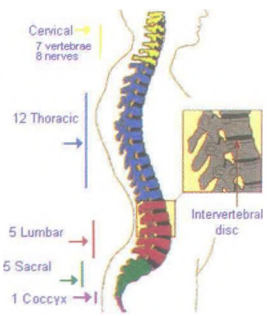


8. **Which of the following is the largest segment of the movable part of the vertebral column?**
   a. Coccygeal
   b. Cervical
   c. Lumbar vertebrae
   d. Thoracic

9. **What is a lateral deviation of the alignment of the vertebral column called?**
   a. Lordosis
   b. Kyphosis
   c. Scoliosis
   d. Lateral Deviation

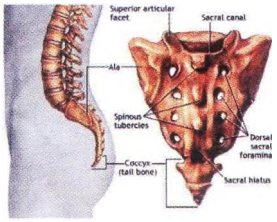


10. **The spinal cord of humans is protected by three layers of tissues collectively known as**
    a. Patella
    b. Ulna
    c. Vertebrae
    d. Meninges



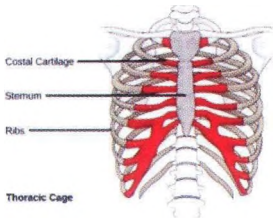
11. Which of the following is the vestigial bony part of a human skeleton?

a. Cervical
b. Cranium
c. Clavicle
d. Coccyx



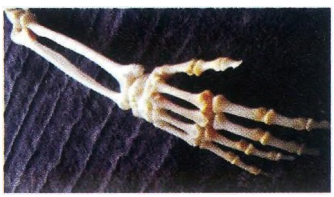
12. What do ribs, sternum, and spine protect?

a. Kidneys, bladder, urethra
b. Heart, lungs, blood vessels
c. Small intestine, large intestine
d. Kidney, lungs, stomach



13. What are the total number of bones in each limb of a man?

a. 14
b. 21
c. 24
d. 30

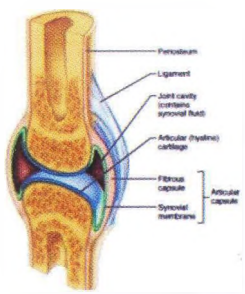


14. The finger bones are also known as

a. Hamate bone
b. Girdles
c. Phalanges
d. Metacarpal

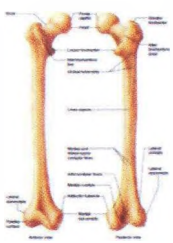
15. The cartilage that is present at the end of long bones is

a. Calcified cartilage
b. Hyaline cartilage
c. Fibrous cartilage
d. Elastic cartilage



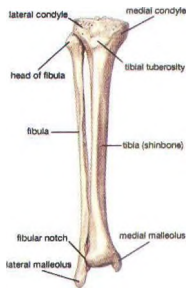
16. Which is the longest and heaviest bone of the body?

a. Femur
b. Fibula
c. Tibia
d. Ilium



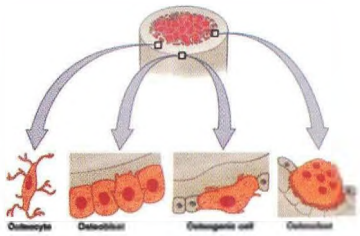
17. The thinnest bone of the human body is

a. Stapes
b. Malleus
c. Incus
d. Fibula



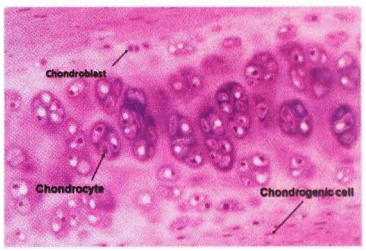
18. Bone matrix consists of an organic compound called

a. Osteoid
b. Osteocytes
c. Osteoclasts
d. Chondrocytes



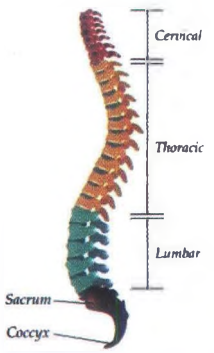
19. Which of the following cell types is responsible for synthesizing the organic component of the cartilage matrix?

a. Osteocytes
b. Chondrocytes
c. Osteoblasts
d. Chondroblasts



20. Which of the following vertebrae is associated with pain in the lower back?

a. Thoracic vertebrae
b. Cervical vertebrae
c. Coccygeal vertebrae
d. Lumbar vertebrae

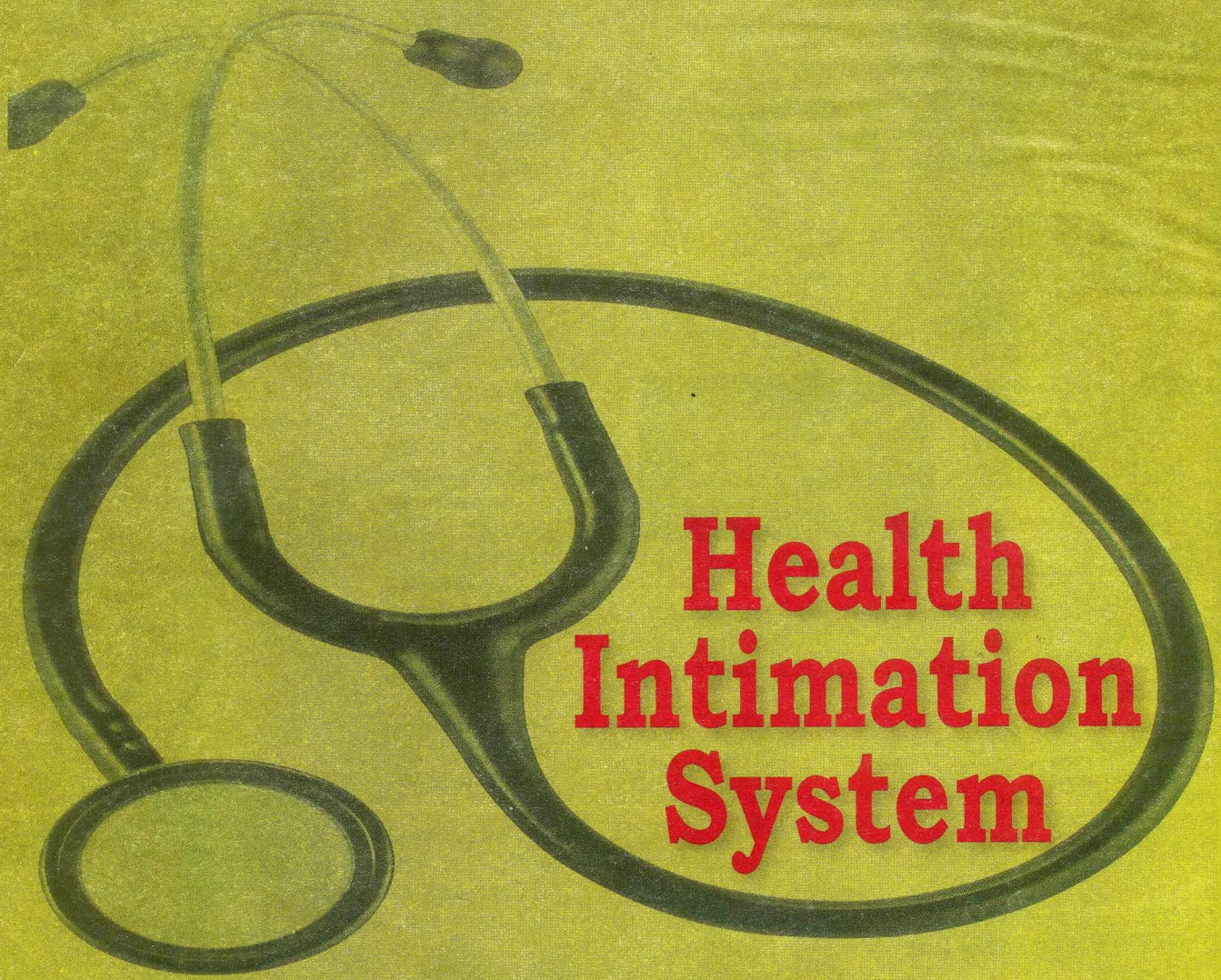


Answers:

1. (d)	2. (c)	3. (b)	4. (b)	5. (b)	6. (c)	7. (b)	8. (c)
9. (c)	10. (d)	11. (d)	12. (b)	13. (d)	14. (c)	15 (b)	16 (a)
17. (d)	18. (a)	19. (b)	20. (d)				

Contributed by Dr Babita Saha, Vice Principal, Bhavan's NSC Bose Vidyaniketan, Haldia, **East Medinipur, West Bengal-721607**. Email: babitasaha@gmail.com

Neel Datta, Student, Bhavan's NSC Bose Vidyaniketan, Haldia, Haldia, **East Medinipur, West Bengal-721607**. Email: neeldatta2005@gmail.com



Health Intimation System

Preeti Lata

Health Intimation System
(Image credit: https://www.pavanempowersolutions.com)

In case of a medical emergency, sometimes senior citizens, physically challenged and the bedridden have no means to reach their loved ones. This problem encouraged rural innovator Kurumala Pavan to devise a "Health Intimation System", which can be used in case of emergency and save someone's life by intimating the kin in the time of need. The Health Intimation System is a GSM-based device indicating the location of the user.

With the help of the device, a bedridden person can remotely be connected to five friends or relatives and in an emergency, the person can press the emergency button and ask for help. Once the button is pressed the device passes the information to their relatives/friends (minimum 5) and also blows a siren to alert nearby people. In fact, the information will pass to all the five numbers on a rotation basis until one of them turns up, reaches the patient and resets the system. The battery back-up of the device is 24 hours and it is also cost effective.

The innovator of the device, Kurumala Pavan belongs to village Moram located in Palamaner Mandal of Chittoor district. He is also the recipient of "Young Scientist" award in 2009 by former President Dr A.P.J. Abdul Kalam. He is known for applying principles of basic sciences to address small yet critical issues in rural areas. He was also awarded by the National Institute of Rural Development (NIRD, Hyderabad) for his amazing innovations in the field of rural health care.

He has also made immense contributions in improving the lives of rural people by his other innovations like remotely operated water pump, home burglar alarm, heartbeat monitoring system and many more through "Pavan Empower Solutions". He manufactures and designs unique instruments which can be afforded by common people.

Contributed by Ms Preeti Lata, *Science Reporter*, CSIR-NISCAIR, New Delhi

Sailor's Eyeball Alga
(Image Credit: Sciencealert.com)

Sailor's Eyeball

Pearl of Sea

Shivani

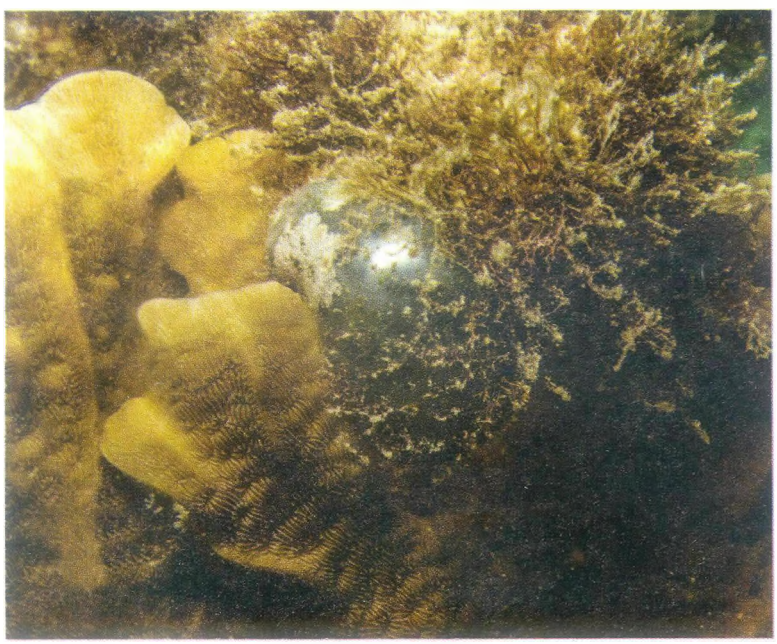
SAILOR'S eyeball (***Valonia ventricosa)*** or green shiny bubble algae, one of the biggest single celled unicellular organisms, are located in tropical and sub-tropical seas. The algae are usually associated with coral rubble and coral reefs and have a spherical to oval shape surface, looking like a precious gemstone. It is mainly found in groups or in giant single cell structures. The algae spreads all over the western central Atlantic and Pacific oceans.

The algae easily grow to 4 cm in diameter. Sometimes they are found living in small clumps; the young ones are translucent green in colour. The older ones are covered or decorated with a hard surface layer of algae. The Sailor's eyeball is considered one of the largest organisms where many multicellular life forms live.

Valonia ventricosa has multiple nuclei, chloroplast and large central vacuoles. The cells usually look green but when they reflect light they appear black or silver in colour. The different colour of the algae is determined by the quantity of chloroplast of the specimen. When the cells are clean they shine like smooth glass. The thallus is made up of multinucleate thin walled cells having a diameter of 4 cm and reaching up to 5 cm in rare cases.

The parent cell reproduces in the form of segregative cell division where multinucleate mother cells make

Sailor's eyeball attached with coral rubble
(Image Credit: newheavenreefconservation. org)



Sailor's Eyeball in groups
(Image credit: iNaturalist)

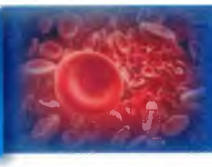
daughter cells. The rhizoids (individual) form a new type of bubble structures and then separate from the mother cell. The cell looks like a balloon full of organelles.

The cells are unique because they are unusually large in shape and size. Due to their larger size we can easily study the different types of transfer of water and water soluble material across these biological membranes.

Interesting Facts

- The algae are unique because the cell wall takes its own shape.
- The cells multiply very fast.
- If the cells grow in fish tanks, they absorb all the oxygen and kill the fishes.

Contributed by Ms Shivani, *Science Reporter*, CSIR-NISCAIR, New Delhi



BLOOD

Raashid Jamaal

1. **The matrix of blood is known as**
   a) Plasma b) Serum
   c) RBC and WBC d) Platelets

2. **The life span of RBC is**
   a) 100 days b) 110 days
   c) 120 days d) 130 days

3. **The ratio of WBC:RBC in human blood is**
   a) 1:60 b) 1:600
   c) 1:6000 d) 1: 60000

4. **During blood coagulation, thromboplastin is released by**
   a) RBC b) Blood Plasma
   c) Leucocytes d) Platelets

5. **The normal level of HB per ml of blood in women is**
   a) 14 g b) 18 g
   c) 20 g d) 10 g

6. **Blood circulation was first explained by**
   a) Jenner b) Harvey
   b) Mendel d) Pasteur

7. **Normal blood pressure of a healthy person is**
   a) 120/100 b) 110/90
   c) 120/80 d) 120/90

8. **What is the name of iron-containing proteins that give red colour to blood?**
   a) Hemocyanin b) Cytochrome
   c) Hemoglobin d) Myoglobin

9. **Which of the following is the body's largest blood vessel?**
   a) Aorta b) Capillaries
   c) Pulmonary Vein d) Heart

10. **Which of the following are the components of blood?**
    a) Plasma and WBC's
    b) Blood cells and Platelets
    c) Gases and other dissolved substances
    d) All of the above

11. **The_____ produces red blood cells, which transports _____ and some _____.**
    a) Liver, oxygen, mineral ions
    b) Liver, oxygen, carbon dioxide
    c) Bone marrow, oxygen, hormones
    d) Bone marrow, oxygen, CO_2

12. **Which of these is required for the conversion of prothrombin into active thrombin?**
    a) Ca^{2+} b) Fe^{2+}
    c) Mg^{2+} d) Mn^{2+}

13. **The process of formation of red blood cells is called**
    a) Haemolysis b) Haemocytolysis
    c) Haemocytosis d) Haemopoiesis

14. **The blood clot is mainly due to**
    a) Plasma and RBC
    b) Plasma and thrombocytes
    c) Heparin and corpuscles
    d) Fibrin and corpuscles

15. **Blood platelets are present in the blood of**
    a) Fishes b) Reptiles
    c) Mammals d) Amphibians

16. **Which of the following lacks blood supply?**
    a) Bone b) Cartilage
    c) Connective tissues d) None of the above

17. **Which blood corpuscle is largest in diameter?**
    a) Neutrophil b) Monocyte
    c) Lymphocycte d) Platelets

18. **Out of these, protein percentage is highest in**
    a) Plasma b) Lymph
    c) Blood d) WBC

19. **Heparin is secreted by**
    a) Kidney b) Blood cells
    c) Nerve cells d) Liver

Answers:

1. (a) 2. (c) 3. (b) 4. (d) 5. (a) 6. (b) 7. (c) 8. (c)
9. (a) 10. (d) 11. (d) 12. (a) 13. (d) 14. (d) 15. (c) 16. (b)
17. (b) 18. (c) 19. (d)

Contributed by Raashid Jamaal, Nana Sahab Ka Bara Bajaria-Dholpur, Rajasthan-328001

ONCOLOGY

Femina Anjum

1. **Oncology is the branch of medicine that researches, identifies and treats**
   a. Cancer b. Asthma
   c. Fever d. None of the above

2. **A physician who works in the field of oncology is**
   a. Chemist b. Oncologist
   c. Nutritionist d. Psychiatrist

3. **The diagnosis of cancer is usually carried out by**
   a. Blood tests b. Biopsy and endoscop
   c. X-ray and MRI d. All of the above

4. **Cancer begins when cells in a part of the body start to grow**
   a. Controlled b. Uncontrolled
   c. Both of the above d. None of the above

5. **Common symptoms that point towards a cancer include**
   a. Fatigue and weight loss
   b. Unexplained anaemia
   c. Fever of unknown origin
   d. All of the above

6. **Oncology is often linked with hematology, which is the branch of medicine that deals with**
   a. Muscles b. Brain
   c. Blood and blood-related disorders d. Skin

7. **Chemotherapy is given for**
   a. Destruction of cancer cells
   b. Immobilization of cells
   c. Blood clotting
   d. None of the above

8. **The treatment which is gaining popularity for cancer treatment is**
   a. Hormone therapy
   b. Radiation therapy
   c. Monoclonal antibody treatment
   d. None of the above

9. **The medical speciality that focuses on cancer care for children is**
   a. Pediatric oncology b. Toxicology
   c. Oncology d. Gerontology

10. **The risk factors for cancer are**
    a. Alcohol and tobacco
    b. Obesity and age
    c. Immunosuppression and oncogenic substances
    d. All of the above

11. **Infectious agents that can cause cancer are**
    a. Oncoviruses b. Mycoplasma
    c. Fungi d. Only mycoplasma

12. **Treatment of cancer with chemotherapy, targeted therapy, immunotherapy, and hormonal therapy is**
    a. Surgical oncology
    b. Radiation oncology
    c. Medical oncology
    d. Clinical oncology

13. **The risk of cancer is much higher for those**
    a. Who smoke and drink alcohol
    b. With bad eating habits
    c. With low physical activity
    d. With increased cholesterol level

14. **The median age of cancer diagnosis is**
    a. 52 years b. 34 years
    c. 66 years d. 78 years

15. **The viruses that can cause cancer**
    a. DNA viruses b. RNA viruses
    c. Both DNA and RNA viruses d. None of the above

16. **Abnormal cell growth with the potential to invade or spread to other parts of the body**
    a. Metastasis b. Hypostasis
    c. Hemostasis d. Venostasis

17. **The tumours which do not spread**
    a. Malignant b. Benign
    d. Both of the above d. None of the above

18. **The vast majority of cancers are**
    a. Non-hereditary b. Sporadic
    c. Both of the above d. None of the above

19. **Some hormones play a role in the development of cancer by promoting**
    a. Cell proliferation b. Growth
    c. Height d. Weight

Answers:

1. (a)	2. (b)	3. (d)	4. (b)	5. (d)	6. (c)	7. (a)
8. (c)	9. (a)	10. (d)	11. (a)	12. (c)	13. (a)	14. (c)
15. (c)	16. (a)	17. (b)	18. (c)	19. (a)		

Contributed by Femina Anjum, PhD scholar (Animal Biotechnology), Rajasthan University of Veterinary and Animal Sciences, Near Char Perron Ki Dargha, Sadul Colony, Bikaner, Rajasthan-334001. Email: feminaanjum@gmail.com

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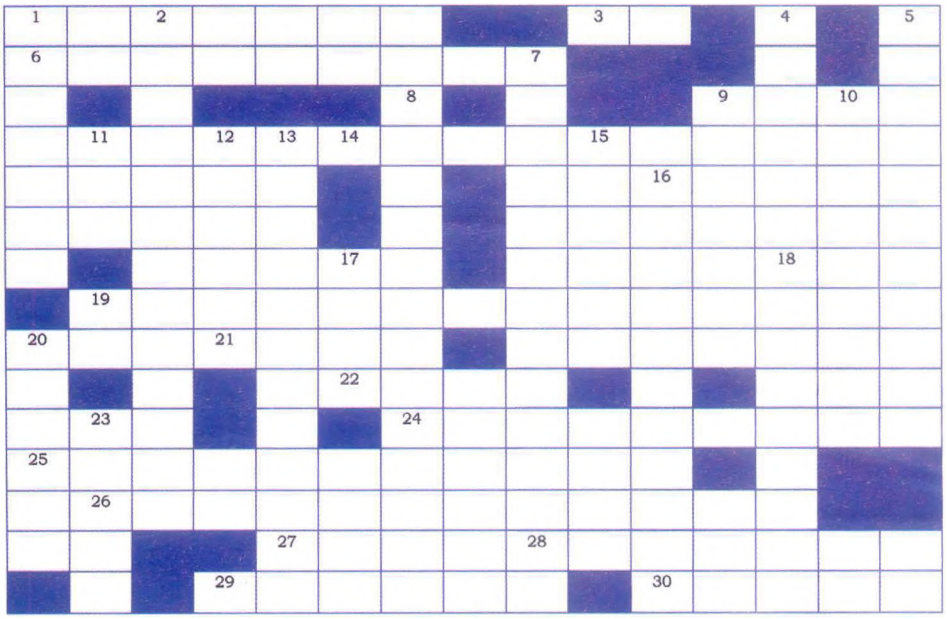

1. A mollusc with a shallow ear shaped shell lined with mother of pearl (7)
3. Chemical symbol of mercury (2)
6. Spine is also called ___ (8)
14. Of or like earth or soil (6)
19. Extensive uncultivated eroded tracts in arid areas (8)
20. Chemical symbol of caesium (2)
21. A unit of liquid or dry capacity equal to 1/8th of a gallon (4)
22. Very strong wind or storm (4)
24. A simple sugar present in many polysaccharides (9)
25. One of the D vitamins essential for the deposition of calcium in bones (10)
26. The study of fishes is called ___ (11)
27. A dark spot in the skin (6)
28. Disaccharide sugar occurring in milk (7)
29. A soft bodied legless larva in decaying matter (6)
30. A unit of weight equal to 1/6th of a pound (5)

Down:

1. A swollen area accumulating pus within a body tissue (7)
2. A rechargeable electric cell (11)
4. An opaque variety of quartz usually red, yellow or brown (6)
5. Substance capable of destroying bacteria (11)
7. Structured set of data held in a computer (8)
8. Strongly interacting subatomic particle (6)
9. The distance over which something can be heard (7)
10. A room for photographic work with normal light excluded (8)
11. Dichloro diphenyl trichloro ethane (3)
12. Denoting a factor of 10^{-9} (4)
13. Cosmetic surgery to remove wrinkles (8)
15. A person who uses computers to gain unauthorized access to data (6)
16. A condition with yellowing of the skin or white of the eyes often caused by obstruction of the bile duct or by liver diseases (8)
17. The tooth of a venomous snake (4)
18. A form of entertainment in which people sing popular song as soloists against a pre-recorded backing (7)
20. A blind ended pouch at the junction of the small and large intestine (6)
23. A small plant with white petalled flowers (5)

Contribited by Raashid Jamaal. Address: Nana Sahab Ka Bara, Bajariya, Dholpur, Rajasthan-328001

Solution To MARCH 2020

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COLLAGEN

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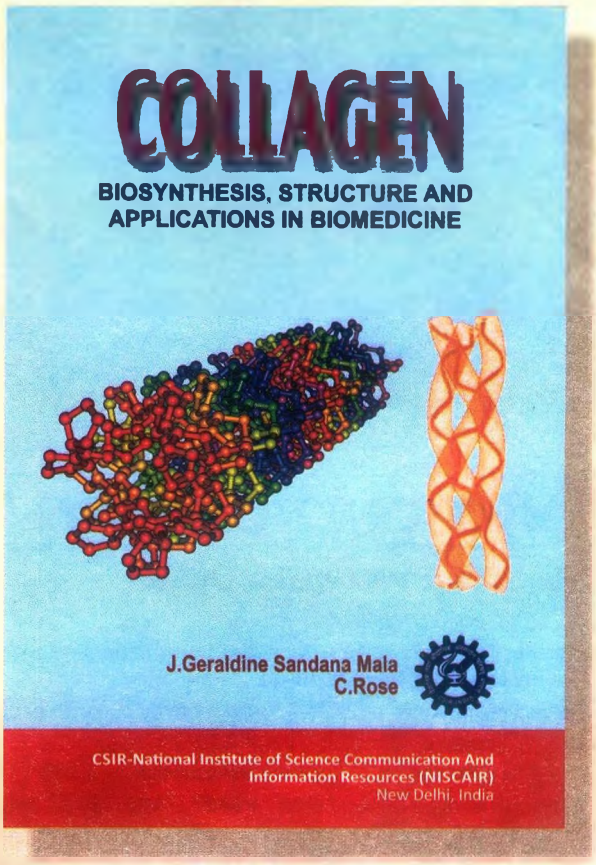

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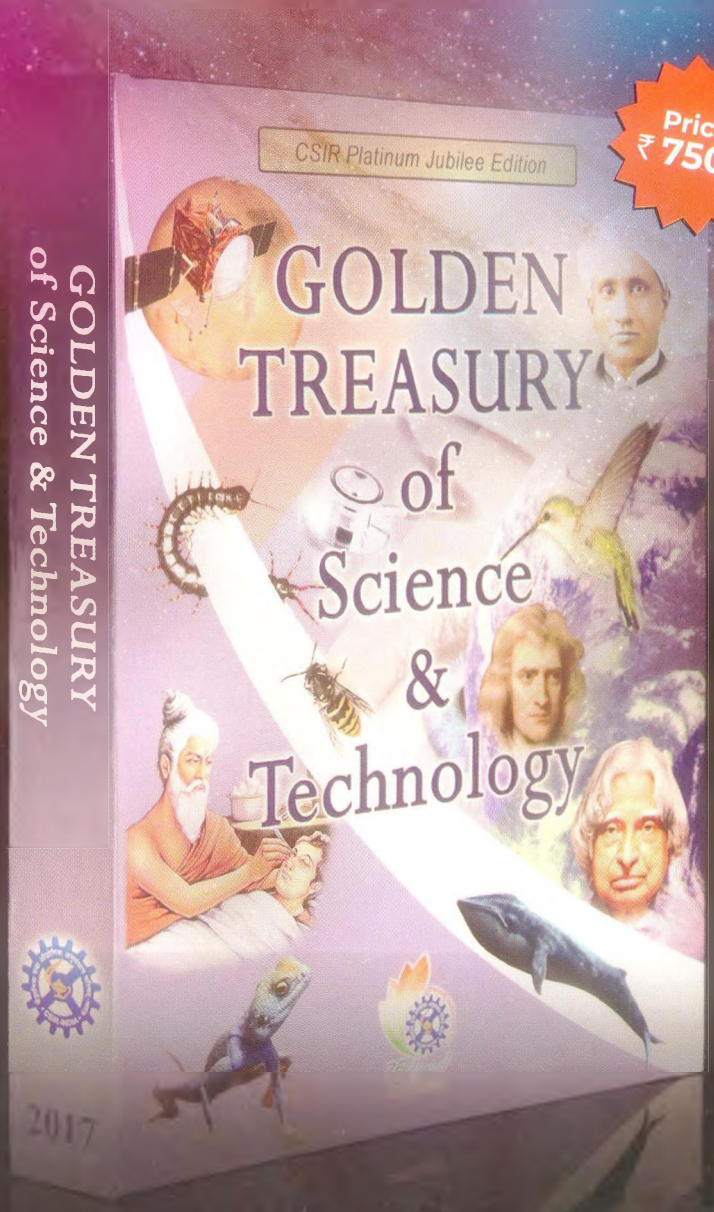

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